IGCC MARKET PENETRATION STUDY FOR THE EAST CENTRAL AREA RELIABILITY (ECAR) COORDINATION AGREEMENT REGION

TOPICAL REPORT

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May 2002

Client:

United States Department of Energy
National Energy Technology Laboratory

Contract Number:

DE-AE26-00NT50516

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LIST OF ABBREVIATIONS AND ACRONYMS

BAU	business-as-usual
Btu	British thermal unit
CoCo	cofeed-coproduction
ECAR	East Central Area Reliability
EIA	Energy Information Administration
GWh	gigawatt hour
IGCC	Integrated Gasification Combined Cycle
kW	kilowatt
kWh	kilowatt-hour
LNB	low-NOx burners
LSFO	limestone forced oxidation
MM	million
NEPEX	New England Power Exchange
NERC	North American Electric Reliability Council
NETL	National Energy Technology Laboratory
NGCC	natural gas combined cycle systems
NYPP	New York Power Pool
PC	pulverized coal
PFBC	pressurized fluidized bed combustion
PJM	Pennsylvania, New Jersey, Maryland interconnect
RCM	Regional Compliance Model
ROE	return on equity
SCR	selective catalytic reduction
SNCR	selective non-catalytic reduction
U.S. DOE	United States Department of Energy

I. EXECUTIVE SUMMARY

Introduction

Mitretek Systems and CONSOL Energy Inc. Research and Development have conducted a study to estimate the potential market penetration of advanced Integrated Gasification Combined Cycle (IGCC) technology as a means of producing domestic electric power from coal in 2010. The primary objective of this study was to provide the National Energy Technology Laboratory (NETL) with information to aid in the development of a strategic marketing plan for commercial domestic deployment of advanced IGCC technologies for coal-based power generation.

Previous Evaluation of Northeasten United States

A previous study[1] examined advanced IGCC market penetration potential for baseload power generation in the northeastern United States. Those results were based on technology costs and performance for advanced IGCC systems identified in a report[2] issued by Parsons Inc. in 1998. That report is based on advancements in both IGCC cost and performance that reduce capital costs to $961/kW and heat rate to 6,870 Btu/kWh.

The current study expands the market penetration analysis to the East Central Area Reliability (ECAR) coordination agreement region of the North American Electric Reliability Council (NERC). As one of the largest NERC regions in terms of power generated, ECAR results can be used as a benchmark for extrapolating results to other NERC regions east of the Mississippi river for which the main fuel supply for power production is bituminous coal.

In the northeast region analysis, all compliance options were evaluated at a fixed capacity factor of 85%, and the mix of technologies giving the lowest cost of electricity was chosen. In reality, power plants generally dispatch at capacity factors dictated by their operating (marginal) costs. That is, competitive prices for generation are based on the costs of producing the last kilowatt-hour of electricity.

Purpose of Study

The purpose of this analysis was to evaluate the economic competitiveness of advanced IGCC technology versus alternative power generation technologies. It was not intended to predict quantitatively the number of IGCC systems installed during a particular point in time. Energy Information Administration (EIA) load growth projections were used to establish electric power generation demand in 2010. That demand was satisfied by adding all new capacity in that single year. In reality, new generation capacity will be added incrementally, each year, as needed.

ECAR Base Case

In contrast to the northeastern United States study, economic dispatch was applied to the analysis of the ECAR NERC region. The lowest incremental-cost unit available was dispatched first with additional units added until the demand was satisfied. Unit availability was based upon historic average availabilities for units of the same type. This dispatch method is identical with standard utility practice, in which units are dispatched primarily by operating costs.

An estimate of power demand in 2010 was made by applying the U.S. EIA load growth projections[3] to the ECAR region. Applying these projections results in a 610,000 GWh power demand in 2010.

CONSOL Energy's Regional Compliance Model (RCM) was used to evaluate various emissions compliance options at varying gas price escalation rates and carbon taxes. Natural gas prices were escalated at rates of 0.92, 2.0, 3.0 and 4.0%/yr, which correspond to annual average prices of $3.53, $4.05, $4.60, and $5.21 MM Btu, respectively, in 2010. Carbon taxes were varied from 0-100/tonne in $25/tonne increments. The emission compliance options considered for the existing coal-fired units were the purchase of emission credits, running the unit "as-is", retrofitting emission controls, seasonal or year-round fuel switching from coal to gas, repowering, and unit replacement.

In the previous study of the northeastern United States, pre-established allowance prices were used for nitrogen oxide (NOx) emissions for both the ozone and non-ozone seasons and for sulfur dioxide (SO_2) emissions year-round. The initial phase of the ECAR analysis was performed using these same allowance prices: $1723/ton of NOx during the ozone season, $259/ton of NOx during non-ozone season periods, and a year-round SO_2 allowance price of $354/ton.

The results of this phase of the analysis show that advanced IGCC systems dominate the new capacity market, except at the lowest (0.92%) gas price escalation with carbon taxes greater than $25/tonne and at a 2% gas price escalation and carbon taxes greater than $50/tonne. In these cases, natural gas combined cycle systems (NGCC) replace advanced IGCC systems. Retrofitting control technology on existing generation units generally satisfies emission limits. Results at the limits of the analysis are shown in Figure 1. Only at the lowest gas price escalation and highest carbon tax do NGCC systems predominate. Even at a $100/tonne carbon tax, IGCC systems dominate new capacity installations when gas prices are escalated at 4.0%/yr (to $5.21/MM Btu in 2010).

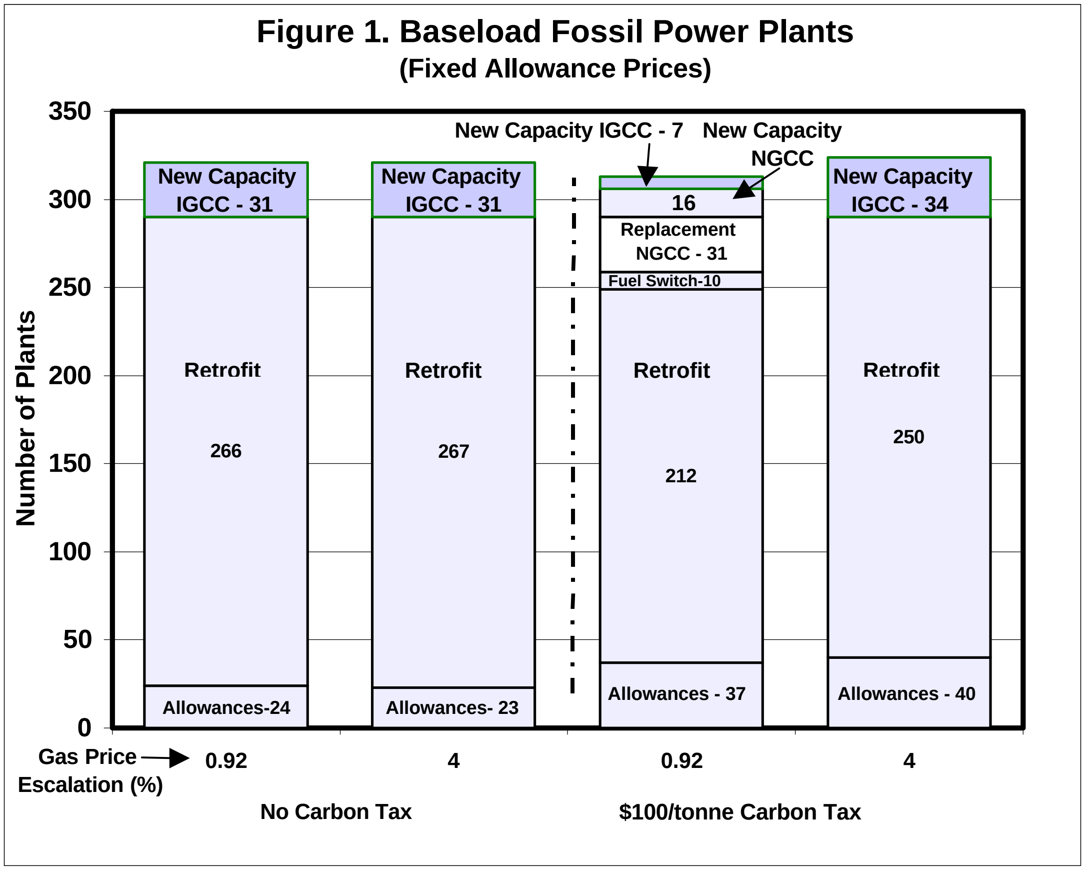
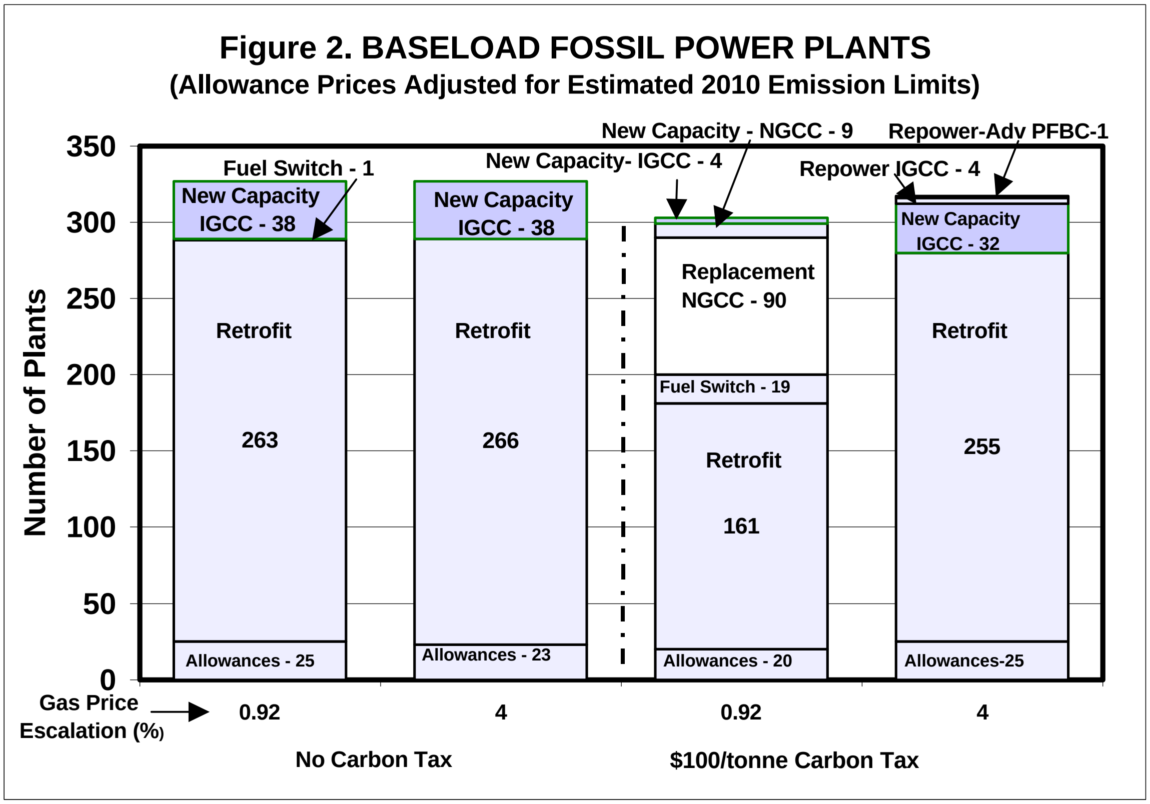


Figure 1 presents the results in terms of number of plants installed. The results are identical in terms of power generated (GW), since advanced IGCC (398 MWe) and NGCC (395 MWe) systems are always preferentially installed because of their superior performance and low cost compared to the other technologies available.

ECAR With More Stringent Emission Limits

The emission limits for 2010 are subject to change. However, regulations currently in place provide reasonable guidance to potential NOx and SO_2 limits in that time frame. In addition, it appears almost certain that fine particulate matter (those particles smaller than 2.5 microns in diameter) will be regulated by 2010. Particulate matter in this size range generally is composed of approximately 50% sulfates in the ECAR region. For this analysis, it was assumed that FGD scrubbers would be used to reduce sulfur dioxide even further than required by the Clean Air Act Amendments of 1990 (under the presumption this also would reduce sulfate particulate in the atmosphere). Therefore, for the purposes of this evaluation, SO_2 emission limits from the ECAR region were reduced to half the currently prescribed limit. Although somewhat arbitrary, this does provide for some accounting of limits that may be in place by 2010. To meet the emission limits imposed in this portion of the study, NOx allowance prices were set at $1500/ton (year-round) and SO_2 allowances at $800/ton.

At these allowance prices, as in the earlier case, advanced IGCC systems dominate the new capacity market, except at a 0.92% gas price escalation combined with carbon taxes greater than $25/tonne and at a 2% gas price escalation combined with carbon taxes greater than $50/tonne. In these cases, natural gas combined cycle systems (NGCC) replace advanced IGCC systems. Retrofitting control technology on existing generation units generally satisfies emission limits. Results at the limits of the analysis are shown in Figure 2.



Generally, the increased allowance prices tend to favor new technology installations rather than technology retrofits. For example, at a 0.92% gas price escalation and no carbon tax, 39 advanced air blown IGCC units are installed versus 31 units with the lower allowance prices. Seventy-four existing plants retrofit FGD scrubbers at the $800/ton SO_2 allowance price versus only ten units at the $354/ton SO_2 allowance price (the remaining retrofits shown in Figure 2 are NOx retrofits). The larger number of new plant installations is necessitated by a reduction in the capacity factor of existing plants.

To illustrate the selection process used by the CONSOL Regional Compliance Model for retrofitting and/or replacing existing coal-fired boilers, and adding new generation capacity, several examples are presented in Section VI. These examples show the data that were used in the decision process for specific scenarios.

ECAR With Less Advanced IGCC and More Stringent Emission Limits

An analysis was performed to determine the impact of less advanced IGCC cost and performance targets. This analysis was performed at the previously established \$800/ton SO_2 and \$1500/ton NOx allowance prices. As expected, the number of IGCC units installed declines as the heat rate and capital cost increase. However even with a 20% increase in IGCC heat rate, IGCC systems dominate new capacity in cases with no carbon tax, as shown in Figure 3. The impact of a 20% increase in IGCC capital cost is shown in Figure 4. Here, IGCC market penetration is very dependent on gas price escalation.

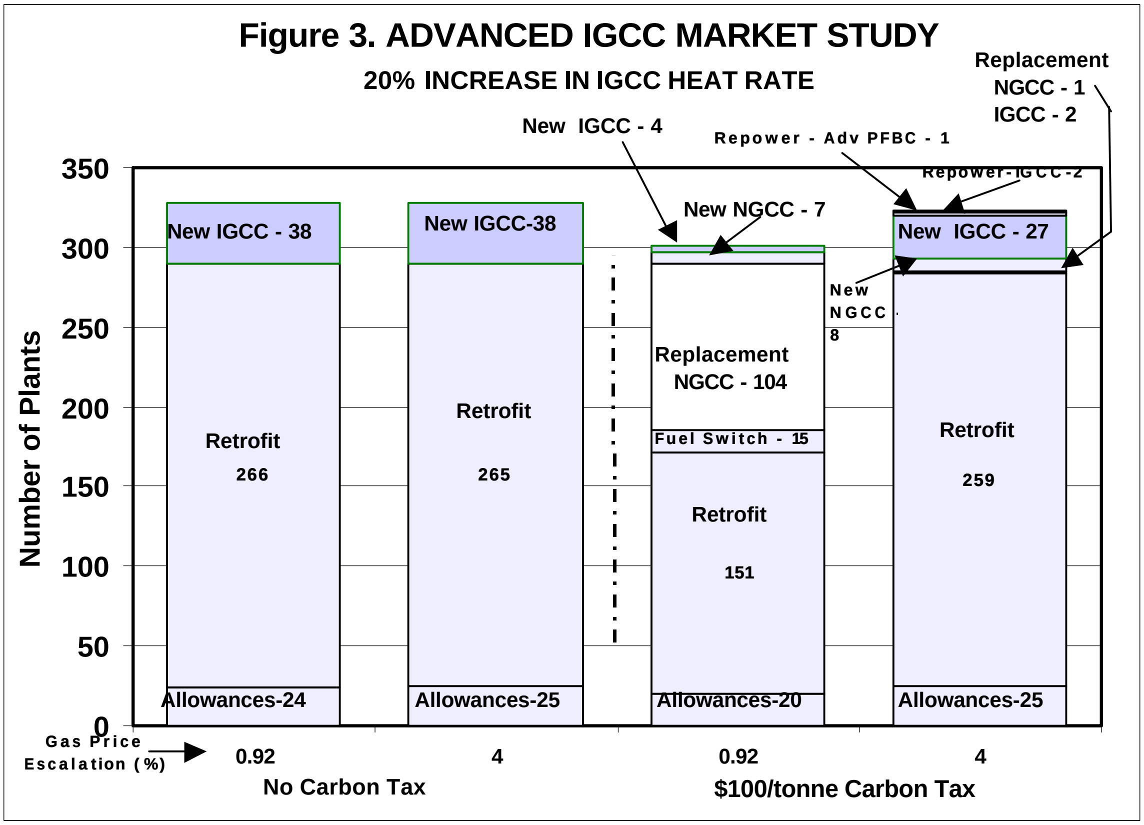
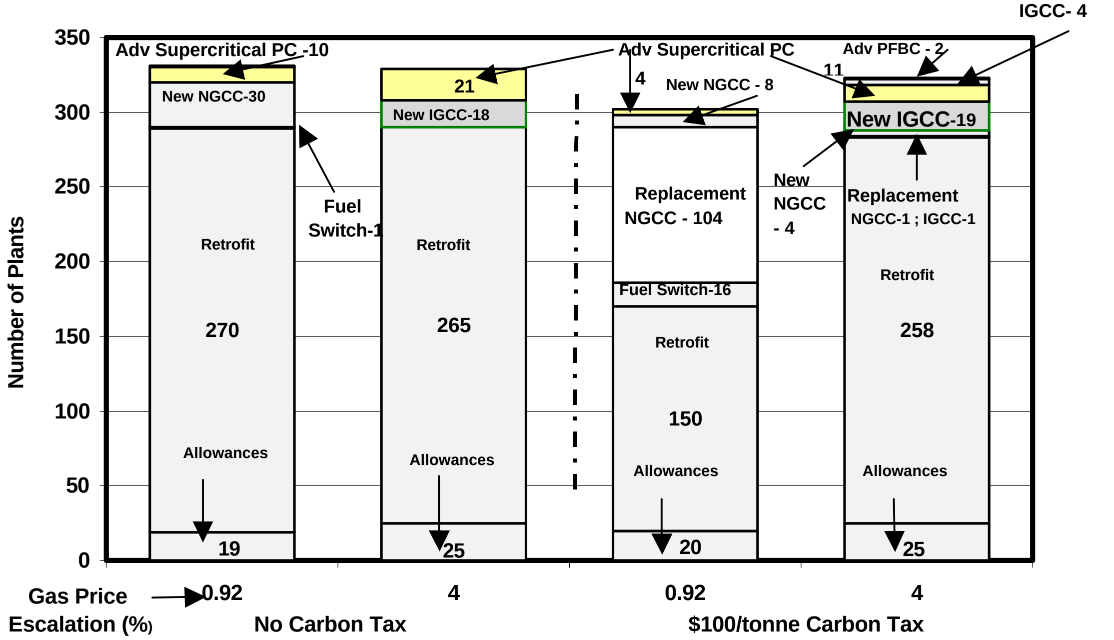


Figure 4. ADVANCED IGCC MARKET STUDY

20% INCREASE IN IGCC CAPITAL COST



With a simultaneous 20% increase in both capital cost and heat rate, IGCC systems are economically non-competitive compared to other technologies available, and none are deployed over the range of gas price escalations and carbon taxes evaluated. However, if the increase is limited to 10% in both, IGCC systems are competitive in many scenarios, as illustrated in Figure 5.

Carbon Dioxide Emissions

The effect of carbon taxes was evaluated in this study because of their possible imposition at some time in the relatively near future to mitigate carbon dioxide emissions to the atmosphere and their apparent effect on global warming. Natural gas and advanced coal based technologies are inherently lower emitters of carbon dioxide compared to conventional PC units. Therefore, when these technologies are installed to meet added demand or replace inefficient existing boilers, the level of carbon dioxide emitted per unit of electricity generated decreases.

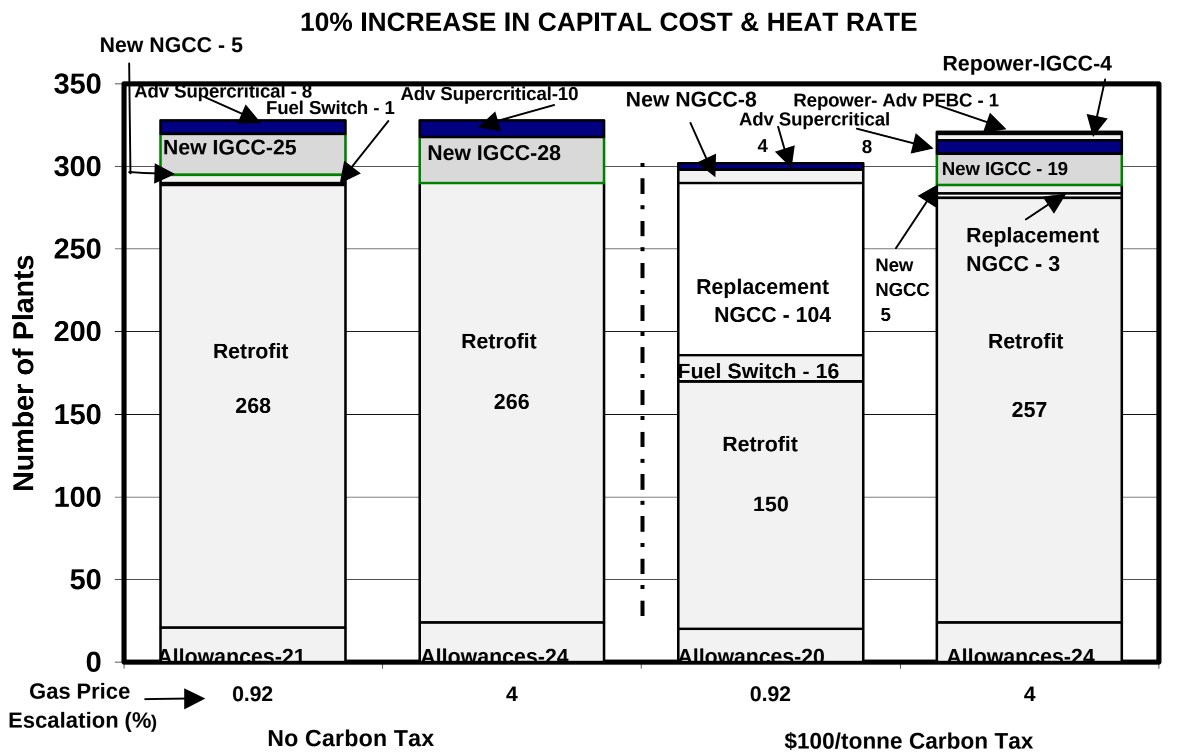
Despite the imposition of carbon taxes, advanced IGGC systems remain economically competitive except at very low gas price escalations and very high carbon taxes. Carbon dioxide emission reductions are only significant (i.e., >10% of base case emissions) at a 0.92% gas price escalation with carbon taxes of $75/tonne or greater and at a 2% gas price escalation combined with a $100/tonne carbon tax.

General Conclusions

The general conclusions of this study follow:

- At base case conditions (0.92%/yr gas price escalation, no carbon tax), advanced IGCC systems dominate new capacity installations in 2010.
- Advanced IGCC systems will play a significant role in meeting energy demand in 2010, except at low gas price escalations combined with high carbon taxes.
- Economic dispatch favors efficient advanced IGCC and NGCC systems. When installed, IGCC systems dispatch at their availability.
- Advanced IGCC systems will play a significant role in new power generation in 2010, even if capital cost and heat rates are 10% greater than currently estimated.
- At base case conditions, carbon dioxide emission reductions are only significant (i.e., >10% of base case) at carbon taxes greater than or equal to $75/tonne.

Figure 5. ADVANCED IGCC MARKET STUDY



II. INTRODUCTION

Mitretek Systems of McLean, Virginia, and CONSOL Energy Inc. Research and Development of South Park, Pennsylvania, are conducting a market penetration study of Integrated Gasification Combined Cycle (IGCC) technology as a means of producing domestic electric power from coal in 2010. The National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE) funded this study.

The objective of the study is to provide NETL with information to aid in the development of a strategic marketing plan for commercial domestic deployment of IGCC technologies for coal-based power generation. Major drivers of the electric market examined in the study are technology development, environ-mental issues, and demand growth.

A previous study[1] examined advanced IGCC market penetration potential for baseload power generation in the northeastern United States. The current study expanded the market penetration analysis to the East Central Area Reliability (ECAR) coordination agreement region of the North American Electric Reliability Council (NERC). As one of the largest NERC regions, ECAR results can be used as a benchmark for extrapolation of the results to the remainder of the United States.

This study was performed under a range of scenarios to encompass, to the extent possible, various factors that may be in place for power generation in 2010. This includes known or anticipated emission limits, NOx and SO_2 allowance prices, carbon taxes, fuel price escalation, and level of technology advancement. These results are intended as an aid to DOE in formulating research and development objectives for electric power generation in the United States.

III. SUMMARY OF RESULTS

A. <u>Fixed Allowance Prices</u>

In the previous study of the northeastern United States, pre-established allowance prices were used for nitrogen oxides (NOx) emissions for both the ozone and non-ozone seasons and for sulfur oxides (SO_2) emissions year-round (a NOx allowance price of $1723/ton during the ozone season, a non-ozone season NOx allowance price of 259$/ton, and a SO_2 allowance price of $354/ton). The initial phase of the analysis of the ECAR region was performed using these same allowance prices.

IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 6 as number of plants constructed and in Figure 7 as power generated. Detailed results are shown in Tables 1A, 1B, and 1C. Advanced IGCC systems dominate the new capacity market except at a 0.92% gas price escalation with carbon taxes greater than $25/tonne and at a 2% gas price escalation and carbon taxes greater than $50/tonne. In these cases, natural gas combine cycle systems (NGCC) replace advanced IGCC systems. Retrofitting control techology on existing generation units generally satisfies emission limits.

B. <u>Allowance Prices Set to Match Emission Limits</u>

The emission limits set for 2010 are subject to change. However, regulations currently in place provide a reasonable guide to NOx and SO_2 limits in 2010. In addition, it appears almost certain that fine particulate matter (those particles smaller than 2.5 microns in diameter) will be regulated by 2010. Particulate matter in this size range generally is composed of approximately 50% sulfates in the ECAR region. For this analysis, it was assumed that FGD scrubbers would be used to reduce sulfur dioxide even further than required by the Clean Air Act Amendments (under the presumption this would also reduce sulfate particulate in the atmosphere). Therefore, for purposes of this evaluation, SO_2 emission limits from the ECAR region were reduced to half the currently prescribed limit. Although somewhat arbitrary, this does provide for some accounting of limits that may be in place by 2010. To meet the emission limits imposed in this portion of the study, NOx allowance prices were set at $1500/ton (year-round) and SO_2 allowances at $800/ton.

Advanced IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 8 as number of plants constructed and in Figure 9 as power generated. Detailed results are shown in Tables 2A, 2B, and 2C.

Advanced IGCC systems dominate the new capacity market except at a 0.92% gas price escalation and carbon taxes greater than $25/tonne and at a 2% gas price escalation and carbon taxes greater than $50/tonne. In these cases, natural gas combined cycle systems (NGCC) replace advanced IGCC systems. Retrofitting control technology on existing generation units generally satisfies emission limits.

Generally, increased allowance prices tend to favor new technology installations rather than technology retrofits. A comparison of the effect of allowance price on advanced IGCC systems installed in 2010 is shown in Figure 10. For example, at a 0.92% gas price escalation and no carbon tax, 39 advanced air blown IGCC units are installed versus 31 units with the lower allowance prices. Seventy-four existing plants retrofit FGD scrubbers at the $800/ton SO_2 allowance price versus only ten units at the $354/ton SO_2 allowance price. The larger number of new plant installations is necessitated by reduction in the capacity factor of existing plants.

There are exceptions to this generalization, however. At a 0.92% gas price escalation, the number of IGCC systems at a $354/ton SO_2 allowance price exceeds the number at an $800/ton SO_2 allowance price. The same situation occurs at $100/tonne carbon taxes at 2 and 3% gas price escalations. This is due to the fact that in these cases a large number of existing coal-fired boilers are replaced with natural gas combined cycle systems (NGCC). Consider the case of 0.92 % gas price escalation and $100/tonne carbon tax. With a $354/ton SO_2 allowance price, 31 existing coal fired-boilers are replaced with NGCC systems. At an $800/tonne SO_2 allowance price, 90 existing coal-fired boilers are replaced with NGCC systems. Since relatively high SO_2 emitting systems are replaced with relatively low SO_2 emitting technology, SO_2 emissions are reduced, and SO_2 allowance prices do not have as large an impact on the results.

C. <u>Status of Technology</u>

Results reported in sections A and B are based on technology costs and performance for advanced IGCC systems identified in a report[3] issued by Parsons Inc. in 1999. That report is based on advancements in IGCC cost and performance that will be attained by the year 2010.

An analysis was performed to determine the impact of lower IGCC cost and performance targets. This analysis was performed at the $800/ton SO_2 and $1500/ton NOx allowance prices established in section B. Results for increases of 10 and 20% in

IGCC capital costs compared to the baseline are shown in Figure 10. As expected, the number of units installed declines as the capital cost increases. The effect is most dramatic at the 0.92% gas price escalation where the number of IGCC systems installed is only significant with no carbon tax.

In Figure 12, a comparison is made between the number of IGCC systems installed at the baseline versus 10 and 20% increases in IGCC heat rate. While the number of IGCC units declines as expected, the decrease as not as dramatic as the 10 and 20% increases in IGCC capital cost shown in Figure 11.

Both capital costs and IGCC heat rate are increased in equal proportions in Figure 13. With a simultaneous 20% increase in both factors, IGCC systems are essentially non-existent. However, if the increase is limited to 10% in both, IGCC systems are competitive in many scenarios.

Actual cost and performance values represented by these cost and performance reductions are shown in Table 3.

IV. CONCLUSIONS

- In a business-as-usual (BAU) condition (0.92% gas price escalation, no carbon tax), advanced IGCC systems dominate new capacity installations in 2010.

- Advanced IGCC systems play a significant role in meeting energy demand in 2010 except at the extreme ranges considered in this analysis (low gas price escalation combined with high carbon taxes).

- Economic dispatch favors efficient advanced IGCC and natural gas combined cycle systems. When installed, IGCC systems dispatch at their availability.

- To meet anticipated emission limits in 2010, SO_2 allowance prices are estimated at $800/ton and NOx allowance prices at $1500/ton (year-round).

- IGCC systems will play a significant role in new power generation in 2010 even if capital cost and heat rates are 10% greater than currently estimated for advanced IGCC systems.

- At BAU conditions, carbon dioxide emission reductions are only significant (i.e., >10% of BAU) at carbon taxes greater than or equal to $75/tonne.

V. DISCUSSION

A. Introduction

1) Previous Study Results

A previous study[1] examined IGCC market penetration for baseload power generation in the northeastern United States, an important market area for IGCC because of the existing coal generation infrastructure and its proximity to coal producing regions. Three utility power pools supply most of the power for the region: the Pennsylvania, New Jersey, Maryland Power Pool (PJM), the New York Power Pool (NYPP), and the New England Power Exchange (NEPEX). There are 110 coal-fired power plants in the region with 14 in NEPEX, 30 in NYPP, and 66 in PJM.

The CONSOL Regional Compliance Model (RCM) model was used to evaluate the options for the northeast region. All of the options were evaluated at a fixed capacity factor of 80 percent and a mix of technologies giving the lowest cost of electricity. Two parameters were investigated in that study. They were the price of natural gas and the imposition of a carbon tax.

Several compliance options were available to the plants in the region. The emission compliance options considered for the existing coal-fired units were the purchase of emission credits, running the unit "as-is", retrofitting emission controls, seasonal or year-round fuel switching from coal to gas, repowering, and unit replacement. These options reflect the desire of utilities to continue to use current generating assets and to replace a unit only if economically justified.

The results of that IGCC market penetration study showed that the most critical factor affecting deployment of IGCC in 2010 was the level of technology advancement that could be achieved. Without improvements in cost and performance, compared to the current state of development, no IGCC market penetration was expected in either the replacement unit or new capacity market segments, regardless of market conditions. That analysis assumed that the current IGCC heat rate and capital cost of the air-blown and oxygen-blown systems are 8,106 Btu/kWh and $1,392/kW, and 8,522 Btu/kWh and $1,241/kW, respectively. Although site-specific and market-condition-specific, IGCC power costs from current technology are greater than other new plant coal-fired technology options.

Performance and cost improvements from the current level of development to an “advanced” level allowed IGCC to effectively compete with advanced NGCC and with other coal-fired technologies in the power market. Advanced technology IGCC had significant market penetration under most market conditions. The advanced technology heat rate and capital cost assumed for that study were 6,870 Btu/kWh and $961/kW respectively, based on recent estimates by Parsons.[2] This represents a 16-20% heat rate improvement and a 23-30% capital cost reduction from current IGCC technologies. At that performance/cost level, IGCC technology was superior to all other coal-fired technologies examined. At a representative plant site in the PJM power pool, for example, advanced technology IGCC power cost was 15-23% lower than current technology IGCC and 6-13% lower than competing coal-fired technologies under business-as-usual (BAU) market conditions.

Over the range of market conditions examined, the maximum market penetration for IGCC occurred at the highest gas price escalation and the highest carbon tax. Even advanced IGCC has no market penetration at the lowest gas price escalation and highest carbon tax (0.54%/yr and $100/tonne C) condition.

2) Dispatch

In the Northeast IGCC Market Penetration study, all of the options were evaluated at a fixed plant capacity factor of 80%. In reality, all power plants dispatch at capacity factors dictated by the operating (marginal) costs. That is, competitive prices for generation are based on the costs of producing the last kilowatt-hour of electricity. Marginal costs are defined as the operation and maintenance (O&M) costs of the most expensive generating plant needed to supply the immediate demand for electricity (the marginal cost of generation). In contrast to the northeastern United States study that used a fixed capacity factor, economic dispatch was applied to the analysis of the ECAR NERC region.

The CONSOL RCM uses historical demand curves to dispatch individual generating units based on incremental operating costs. The lowest incremental-cost unit available dispatches first with additional units added until the demand is satisfied. Unit availability is based upon historic average availabilities for units of the same type. This dispatch method is identical with standard utility practice in which units are dispatched primarily by operating costs. Capital and fixed costs do not enter into the dispatch algorithm. Only the fuel and variable operating costs are used.

The RCM calculations were based on historical data for the ECAR NERC region for the years 1993 through 1997. The model dispatches power based on demand probabilities. It also establishes both random and planned outages. Unit availability is based on historic average availabilities for units of the same type. The model continually iterates capacity factors until convergence is attained. Each plant dispatches at a unique capacity factor and incremental power cost.

3) Objectives of Current Study

The objectives of this study are as follows:

- Estimate the future market potential of IGCC electric power generation for the East Central Area Reliability Coordination Agreement (ECAR) region of the United States in 2010.

- Identify the conditions where IGCC achieves a significant market penetration for baseload power

- Estimate allowance prices to achieve projected emission limits for NOx, SO_2, and Carbon.

- Perform a region-specific market study for 2010, including compliance with environmental regulations, load projections, and available technologies.

- Include power dispatch to generate the true marginal cost of power.

The study evaluated IGCC market potential in 2010 because:

- Significant advances in IGCC and other power generation technologies should be adequately demonstrated and ready for commercialization.
- Implementation of CO_2 emission reduction programs within in the next 5-10 years will require evaluation of an expanded list of compliance options.
- CO_2 allowance prices should be fairly well established.

B. Description of ECAR

The ECAR region encompasses eight east-central states serving 36 million people. Western Pennsylvania, West Virginia, Ohio, Indiana, Kentucky, Michi-gan, and small areas of Virginia and Maryland form this region. Electrical generation capacity is largely coal-fired boilers/steam turbines (85%) with nuclear (7%) and natural gas-fired turbines (5%) making significant contributions. Coal-fired boilers/steam turbines and nuclear energy provide 98% of the power. Power is generated at 119 sites in units ranging in capacity from 10-1300 MWe for coal, 800-1250 MWe for nuclear, 2.5-800 MWe for fuel oil firing, and 20-115 MWe for gas firing. Heat rates vary from 8,600-19,000 Btu/kWh. These plants currently employ a variety of emission controls. The current average system dispatch of these existing units is about 60%.

C. Compliance Options

This analysis assumed that allowances must be purchased for all SO_2, NOx, and CO_2 emissions, regardless of the emission level or whether the unit is an existing or a new unit. It is assumed that the cost of each type of emission allowance will equilibrate to a certain level based on compliance strategies. Overall, this treatment of emissions as an opportunity cost minimizes the costs associated with emissions compliance. The cost of CO_2 allowances was varied because of its profound impact on IGCC market penetration.

Emission Allowance Purchases

For existing coal-fired units, one option is to continue to operate the plant “as-is” and purchase allowances rather than reduce emissions. This strategy can be attractive because no emission control hardware-related capital charges and O&M costs are incurred. For this strategy to be cost-effective, the total cost of allowances must be small.

Unit Modifications

For existing coal-fired units, another option is to modify the unit by retrofitting emission control hardware for SO_2 and/or for NOx.

SO_2 Control

The only SO_2 emission control option evaluated for unscrubbed units is a retrofit limestone forced oxidation (LSFO) wet scrubber. The scrubber is designed to remove 95% SO_2 with large absorbers and no spares. The maximum capacity per absorber is 650 MW. This is the current technology limit. It is assumed that the flue gas streams from large multi-unit power stations are aggregated into a single flue gas desulfurization (FGD) unit. This approach reduces cost and has been demonstrated commercially at several plants.

NOx Control

Various NOx control options and combinations of options are evaluated. The NOx emission levels of the existing units are based on data reported for 1997. The control options evaluated include:

- Low NOx burners (LNB)
- Overfire air
- Selective Non-Catalytic Reduction (SNCR)
- Selective Catalytic Reduction (SCR)
- Coal reburn
- Gas reburn
- Combinations of the above

The boiler firing mode, heat input, and presence of installed control equipment are considered. The SNCR and SCR capital costs are based on a retrofit instal-lation of moderate difficulty. In general, higher year-round NOx allowance costs favors the use of capital-intensive options that display higher removal levels. Large differential seasonal NOx allowance costs favor the use of less capital-intensive options

Fuel Switching

Fuel switching from coal to natural gas is a low-capital-cost option for reducing SO_2, NOx, and CO_2 emissions in existing units. The disadvantages are the decrease in boiler efficiency and higher fuel cost. Net power output increases slightly because of reduced duty of the fuel and ash handling systems, the pulverizers, and the electrostatic precipitator (ESP). It is assumed that a natural gas pipeline is located near each plant. As a result, the only capital cost incurred for this option is for the installation of gas burners.

The two options evaluated are seasonal and year-round fuel switching. Seasonal (May through September) fuel switching is evaluated to minimize NOx emission costs during the ozone season when allowance costs are very high. Fuel switching is evaluated based on the delivered ozone- and non-ozone-season natural gas prices selected for analysis.

Repowering

Repowering is an option that increases capacity, improves power generation performance, reduces emissions, and preserves part of the existing assets for continued use. Generally, repowering is the replacement of the original unit steam supply system and integration of the new steam system into the remainder of the plant. The steam turbine-generator is the most critical item reused. The reuse of other plant systems is maximized. Some systems may require upgrading or refurbishment. The evaluation of repowering is very site specific, and very limited information on performance and cost is available. This study provides an initial and limited evaluation of the repowering option.

Criteria were developed to decide which existing coal units are suitable for repowering, and for the performance and capital and operating costs of the repowered plants. The repowering technologies examined are natural gas-fired G-frame NGCC, and coal-fired advanced IGCC and advanced PFBC. Only single-train repowering designs were considered. For example, a single-gas turbine, single-steam turbine NGCC design was evaluated, while a design with two gas turbines and one steam turbine was not considered. This limitation may result in underestimating the potential for both coal and gas repowering of existing plants. Steam turbine capacity and plant heat rate data were used to decide if a unit is a candidate.

Replacement Units

Fifteen technology options were evaluated as alternatives for replacing the existing units. It was assumed that only the current unit site and general support facilities are reused. The original unit is abandoned and a new unit (from coal handling to the stack) is built. The gas-fired options include three NGCC technologies based on FA, G, and H frame gas turbines. The pulverized-coal (PC) options include subcritical, supercritical, ultrasupercritical, and advanced ultrasupercritical technologies. The PCs are equipped with a LSFO scrubber, low-NOx burners, and a SCR. The IGCC options include one currently available technology, one partially advanced technology, and two advanced technologies. The IGCC market potential is evaluated at each technology level to decide the impact of technology advancement. The pressurized fluidized bed combustion (PFBC) options include one currently available and one advanced technology. Two cofeed-coproduction (CoCo) options, high coal and high gas, are considered to encompass plant design ranges for coal and gas feed rates, power output, and liquid by-product output. The CoCo options are based on a current state-of-the-art technology. The performance and costs of the replacement plant tech-nologies are listed in Table 3.

New Capacity Units

The same technology options considered for replacement units are considered for units providing new capacity. Since units providing new capacity will be built at existing sites and use the same coal (if coal-fired), the performance and cost of the new capacity units are the same as the replacement units. These are listed in Table 3. It is assumed that adequate space exists at each site to construct one or more additional units.

D. Parameters Evaluated

In general, the model was evaluated at varying gas price escalation rates and carbon taxes. Natural gas prices were escalated at rates of 0.92, 2.0, 3.0 and 4.0%/yr. Carbon taxes were varied from 0-$100/tonne in $25/tonne increments. Natural gas prices were escalated from the 1997 baseline. The equivalent gas prices in 2010 at these escalation rates are shown below.

Gas Price Escalation (%/yr)	Ozone Season	Non-Ozone Season	Annual Average
0.92	3.16	3.79	3.53
2.0	3.63	4.35	4.05
3.0	4.12	4.90	4.60
4.0	4.67	5.60	5.21

E. IGCC Market

1. Basis/Assumptions

For the ECAR region, a prediction of the potential power market for 2010 is made by applying the U.S. Energy Information Administration (EIA) load growth projections[3] to the northeast region. Baseload power growth for 2010 is assumed to be the same as general load growth. Future nuclear and hydro capacity is based on EIA growth projections. The contribution of "other" capacity sources is assumed to remain constant – no growth or loss of generation units. Fossil fuel plants, comprising existing coal-fired, new coal-fired, and new gas-fired units, will provide the remaining baseload power. Replacement of existing coal-fired units with lower cost, more efficient coal- or gas-fired technologies generally increases the power generation capacity at existing sites. As required, additional new coal- or gas-fired units are installed at these sites to provide the remaining baseload capacity requirement.

This study assumes that all plants use the current coal at its 1998 price escalated to 2010. The unique properties of that coal are considered when assessing emission reduction technology options. The size (MW), net plant heat rate, availability, and existing emission reduction technologies of each boiler are considered when optimizing technology options. Technology options are not restricted by space availability, infrastructure, or availability of any utilities, including natural gas. The exception is repowering where a match between the existing stream turbine and repowering technology size is necessary for the repowering option to receive consideration. It is further assumed that new generation technology is installed at an existing plant site and uses the coal currently being burned. Transmission limitations are not considered.

Site-specific considerations can influence technology deployment to meet increased power demand. For example, coal costs and characteristics at one site may favor a particular technology, while coal costs and characteristics at another site may favor a different technology. By applying the analysis to a real power generation region, ECAR, the technology mix predicted reflects the fact that no two real world scenarios are identical.

Fuel prices are assumed to escalate at the rates predicted by EIA.[3] EIA predicts that coal prices will de-escalate at 0.69%/yr through 2010, while natural gas prices will escalate by 0.92%/yr.

The coal/natural gas fuel price differential is an important factor in determining the market potential of all coal-fired technologies, including IGCC. This study uses site-specific 1997 coal characteristics and delivered fuel price as a baseline to evaluate each unit. The average delivered coal price for all existing coal-fired units in 1997 was $1.22/MM Btu with a range of $0.84-$1.80/MM Btu. Coal-fired boilers experiencing a high delivered coal price are more likely to switch to gas in the existing boiler or replace the current unit with a NGCC plant. These sites probably will not be economically attractive for installing a new coal unit to satisfy new capacity needs.

It is assumed that the current coal is used in 2010. Although coal switching is possible, the evaluation of this option is very complex and beyond the scope of this study. Coal switching (to Powder River Basin or southern Appalachian coals) in the ECAR region is less likely to occur, compared with the far midwest and southeast regions.

In the economic analyses, leveraged financing is used with an expected return on equity (ROE) of 15%. The financial factors used in the study reflect a non-regulated utility industry and are similar to project financing parameters currently used by non-utility generators (NUGs). These are characterized by leveraged financing, a higher return on investment, and a somewhat shorter project life than is typical for a regulated utility power project. The total project life ranges from 26 to 28 years based on a common 25-year operating life and construction periods from 1 to 3 years. The financial factors used and construction period of each option are shown in Table 4.

In summary, the assumptions made in this study were:

- The analysis would be for 2010.
- Load growth would be 1.64%/yr based on the EIA Annual Energy Outlook 2000.
- ECAR supplies it own power needs (no import or export of power to other NERC regions).
- Existing plants continue to operate until uneconomic.
- Allowances must be purchased for all emissions, including the emissions remaining after control technology is installed.
- Fuel prices were set at the escalation rates shown in EIA Annual Energy Outlook 2000. Deviations from these rates were not considered because the number of potential cases would have been unwieldy.
- The baseline natural gas price escalation rate is 0.92%/yr.
- Nuclear power fuel prices remain essentially unchanged.

2. Methodology

To perform the analysis of the ECAR region, the original RCM was integrated with a power dispatch model. This model applies the lowest cost emission control strategy to each generating unit. Plants are dispatched at the lowest marginal cost that includes fuel price, variable operating and maintenance costs, and emission allowance costs. The model includes the capability to evaluate the effect of natural gas price escalation, carbon taxes, and NOx and SO_2 allowance prices on operating costs.

When existing plants cannot meet the regional power demand, new capacity is added at the lowest overall cost to meet the demand. In this case, capital costs are considered in addition to operating costs. Individual plant capacity factors are adjusted in the model to produce the most economical power dispatch.

The model used for this analysis balances a number of criteria to produce the lowest power cost for the ECAR region. Considerations include existing plant configuration, existing fuel characteristics, retrofit options, replacement options, new technology options, capacity factors, availabilities, fuel prices, carbon taxes, and emission allowance prices. Due to this complexity, slight anomalies can occur when making exact comparisons between different cases. These anomalies are small and do not influence the overall conclusions of the study.

3. Results

a) Fixed Allowance Price

IGCC market penetration was evaluated over a matrix of market conditions. The market conditions examined encompass natural gas price escalation rates of 0.92-4.00% per year and carbon taxes of $0-$100 per tonne of carbon. The SO_2 and NOx emission allowance prices were fixed in this portion of the study at the same values used for the Northeast IGCC Market Penetration Study,[1] including: an ozone season NOx allowance price of $1723/ton, a non-ozone season NOx allowance price of $259/ton, and a year-round SO_2 allowance price of $354/ton. The advanced IGCC technology costs and performance values used in the analysis are those presented in the Parsons Report.[2] IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 14 as number of plants constructed and in Figure 15 as power generated. Detailed results are presented in Tables 1A, 1B, and 1C.

With no carbon tax, the number (31) and generation capacity (12.3 GW) of IGCC plants remains constant at all of the gas price escalation rates evaluated. All capacity constructed to satisfy increased demand is IGCC. No natural gas combined cycle (NGCC) units are built nor are any existing coal-fired boilers replaced. More than 90% of the existing plants comply with emission limits by retrofitting control technology while the remainder buys allowances. Figure 16 shows the total number of plants in operation and the strategy used to meet compliance for these plants. Similar data are shown in Figure 17 in terms of power generated. The technologies used to meet new baseload capacity are presented in Figure 18.

At a $25/ton carbon tax, new capacity is satisfied with IGCC units (32) over the range of gas price escalations evaluated. These units provide 12.7 GW of new generation capacity. No existing coal-fired boilers are replaced. All capacity constructed to satisfy increased demand is IGCC. No natural gas combined cycle (NGCC) units are built. More than 90% of the existing plants comply with emission limits by retrofitting control technology, while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 19. Similar data are shown in Figure 20 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 21.

At a $50/tonne carbon tax, NGCC systems become economically competitive with IGCC at low gas price escalation rates. At a 0.92% gas price escalation, new capacity is almost evenly split between IGCC and NGCC (16 vs. 17 new plants). However, at a gas price escalation of 2.0% or higher, all new demand is satisfied with IGCC units (33) with a generation capacity in the range of 13.1 GW. At the 0.92% gas price escalation, one existing coal-fired boiler switches to natural gas firing. At this carbon tax and over the range of gas price escalations evaluated, 90% of the existing plants comply with emission limits by retrofitting control technology while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 22. Similar data are shown in Figure 23 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 24.

At a $75/tonne carbon tax, the number of new NGCC systems is slightly higher than IGCC systems (15 vs. 20 new plants) at a 0.92% gas price escalation. At a 0.92% gas price escalation, two existing coal-fired boilers are replaced by NGCC systems. At a 2.0% gas price escalation, IGCC regains the economic advantage over NGCC. Twenty-three new IGGC units are constructed versus ten NGCC units. No existing coal-fired boilers are replaced. At the 3.0% and 4.0% gas price escalation rates evaluated, all new capacity is supplied by IGCC systems (13.1 GW). Slightly less than 90% of the existing plants comply with emission limits by retrofitting control technology, while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 25. Similar data are shown in Figure 26 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 27.

The number of IGCC units constructed decreases to seven (2.8 GW) at a $100/tonne carbon tax and 0.92% gas price escalation. In addition, 31 existing coal-fired boilers are retired and replaced with NGCC systems. However, at this same carbon tax and a 2.0% gas price escalation, new capacity is almost evenly split between IGCC and NGCC (18 vs. 19 new plants). In this case, only four existing coal-fired boilers are retired and replaced with NGCC systems. At the 3.0% and 4.0% gas price escalation rates, all new capacity is again IGCC and no existing coal-fired boilers are retired. Most plants still achieve emissions compliance through retrofitting controls, but the number declines to approxi-mately 85%. The remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 28. Similar data are shown in Figure 29 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 30.

In summary, for the allowances prices established here, IGCC systems achieve a significant market penetration in the ECAR region except at a 0.92% gas price escalation ($3.53/MM Btu average annual gas price) combined with carbon taxes of $50/ton or greater. At all other conditions evaluated, the number and generation capacity of IGCC systems equals or exceeds that of NGCC systems.

The average capacity factor for existing units is shown in Figure 31 as a function of gas price escalation and carbon tax. Lines for 3% and 4% gas price escalations overlap. These capacity factors fall in a narrow range of 60-62%. Capacity factors for new units are shown in Figure 32. This is a combination of NGCC and IGCC technologies. In general, new IGCC units dispatch at a higher capacity factor than new NGCC units. This is shown in Figure 33, which plots capacity factor versus carbon tax for new NGCC and IGCC units at a 0.92% gas price escalation.

The average annual generating cost for existing units is shown in Figure 34. Since most existing units are coal-fired, they are unaffected by gas price escalations. The drop in cost at the 0.92% gas price escalation and $100/tonne carbon tax represents replacement of existing coal-fired units with NGCC systems. In this analysis, replacement units are analyzed as an existing units. Here, thirty-one existing coal-fired boilers are replaced with NGCC systems. NGCC systems are more economical under this scenario because of the high carbon tax ($100/tonne).

Average costs for power generation are shown in Figure 35 for new plants. As gas prices escalate, so do power costs.

b) Adjusted Allowance Prices

The approach used in the previous analysis was to use the same SO_2 and NOx emission allowance prices used for the prior northeastern United States study. Those are: an ozone season NOx allowance price of $1723/ton, a non-ozone season NOx allowance price of $259/ton, and a SO_2 allowance price of $354/ton. SO_2 and NOx emissions are generated for each plant in the ECAR region using technology combinations that produce the lowest marginal cost of electricity. The sum is then the total emissions for the ECAR region.

The emission limits expected for 2010 are subject to change over time. However, regulations currently in place or under contemplation provide guidance to expected limits in 2010. These are:

- SO_2 emission limit for the ECAR region of 2.38 million tons (based on Clean Air Act Amendment Title II, Phase 2 acid rain provisions currently in place)

- NOx emission limit of 0.15 lb/MM Btu during the ozone season (based on recently promulgated EPA regulations).

In addition, it appears almost certain that fine particulate matter (those particles less than 2.5 microns in size) will be regulated by 2010. Particulate matter in this size range generally is composed of approximately 50% sulfates in the ECAR region. For the analysis reported in this section, it was assumed that FGD scrubbers would be used to reduce sulfur dioxide even further (under the presumption that this also would reduce sulfate particulate in the atmosphere). Therefore, for purposes of this evaluation, SO_2 emission limits from the ECAR region were reduced to half the currently proscribed limit (from 2.38 to 1.19 million tons). Although somewhat arbitrary, this provides some accounting for additional reductions that are likely to be mandated by 2010.

Currently, NOx emission limits apply only to the ozone season (May through September). However, environmental regulations generally become more stringent with time. Many individual state regulators are already considering imposing year-round NOx limits. It was assumed in this portion of the analysis that, by 2010, technology used to meet ozone season NOx limits would be required year-round.

To meet the emission limits imposed in this portion of the study, NOx allowance prices were set at $1500/ton (year-round) and SO_2 allowances to $800/ton. IGCC market penetration was evaluated at natural gas price escalation rates of 0.92%-4.00% per year and carbon taxes of $0-$100 per tonne of carbon. IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 8 as number of plants constructed and in Figure 9 as power generated. Detailed results are shown in Tables 2A, 2B, and 2C.

With no carbon tax, the number of IGCC plants constructed is constant at 38 over the range of gas price escalations evaluated. This represents approxi-mately 15 GW of generation. One existing coal-fired boiler is replaced with an IGCC system at all gas price escalation rates. One additional coal-fired boiler converts to natural gas firing at the 0.92% gas price escalation. Except for the single replacement unit, IGCC capacity is constructed to satisfy increased demand. Without a carbon tax, no NGCC units are built. More than 90% of the existing plants comply with emission limits by retro-fitting control technology, while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 36. Similar data are shown in Figure 37 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 38.

At a $25/ton carbon tax, new capacity is satisfied with IGCC units (37-39) over the range of gas price escalations evaluated. These units provide approximately 15 GW of power generation. Two existing coal-fired boilers are replaced with IGCC units at 0.92% and 2% gas price escalation, while three existing coal-fired boiler are replaced with IGCC units at 3% and 4% gas price escalations. One coal-fired boiler converts to natural gas firing at the 0.92% gas price escalation. The remainder of IGCC capacity installed is constructed to satisfy increased demand. No natural gas combined cycle (NGCC) units are built at this carbon tax. More than 90% of the existing plants comply with emission limits by retro-fitting control technology while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are presented in Figure 39. Similar data are shown in

Figure 40 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 41.

At a $50/tonne carbon tax, NGCC systems become economically competitive with IGCC at a 0.92% gas price escalation. Here, new capacity is almost evenly split between IGCC (18 new plants) and NGCC (16 new plants). Additionally, five existing coal-fired boilers are replaced with NGCC systems, five more fuel switch to natural gas, and four are repowered with IGCC systems. However, at a gas price escalation of 2.0% or greater, all new demand is satisfied with IGCC units (33-35) with a generation capacity in the range of 13.1-13.9 GW. In addition, four existing coal-fired boilers are replaced with IGCC at a 2% gas price escalation, four more are repowered with IGCC systems, and one is repowered with an advanced PFBC system. At 3% and 4% gas price escalation, three existing coal-fired boilers are replaced with IGCC, four are repowered with IGCC systems, and one is repowered with an advanced PFBC system. At this carbon tax and over the range of gas price escalations evaluated, approximately 80% of the existing plants comply with emission limits by retrofitting control technology while the remainder buys allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are presented in Figure 42. Similar data are shown in Figure 43 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 44.

At a $75/tonne carbon tax, new capacity favors NGCC systems over IGCC (14 vs. 9 new plants) at a 0.92% gas price escalation. At this gas price escalation, 32 existing coal-fired boilers are replaced with NGCC systems, eleven are switched to natural gas firing, and two are repowered with NGCC systems. At a 2.0% gas price escalation, IGCC regains the economic advantage over NGCC. Twenty-two new IGGC units are constructed versus ten NGCC units to satisfy increased demand. However, six existing coal-fired boilers are replaced with NGCC systems, four are switched to natural gas firing, and four are repowered with IGCC systems. At the 3.0% and 4.0% gas price escalations evaluated, all new capacity is supplied by IGCC systems (34-36 units, 13.5-14.3 GW). Four existing coal-fired boilers are repowered with IGCC systems and another with advanced PFBC. Approximately 90% of the existing plants comply with emission limits by retrofitting control technology, while the remainder buy allowances. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 45. Similar data are shown in Figure 46 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 47.

At a $100/tonne carbon tax and 0.92% gas price escalation, only four IGCC units are constructed (1.6 GW). Under these conditions, 90 existing coal-fired boilers are replaced with NGCC units. Nineteen existing coal-fired boilers are switched to natural gas firing. However, at this same carbon tax and a 2.0% gas price escalation, new capacity is almost evenly split between IGCC and NGCC (9 vs. 10 new plants). In this case, 46 existing coal-fired boilers are retired and replaced with NGCC systems and five existing coal-fired boilers switch to natural gas firing. At a 3.0% natural gas price escalation, 27 new IGCC systems are constructed to meet demand while only three NGCC systems are installed. Two existing coal-fired boilers switch to natural gas firing, and seven are replaced by NGCC systems. Five existing units are repowered, four with

IGCC, one with NGCC, and one with advanced PFBC. At a 4.0% gas price escalation rates, all new capacity is again IGCC. Five existing coal-fired boilers are retired and replaced with IGCC. Five are repowered. Four of the repowered units are IGCC and one an advanced PFBC. Most plants still achieve emissions compliance through retrofitting controls. The total number of plants in operation and the strategy used to meet compliance for these plants are shown in Figure 48. Similar data are shown in Figure 49 in terms of power generated. The technologies used to meet new baseload capacity are shown in Figure 50.

The average capacity factor for existing units is shown in Figure 51 as a function of gas price escalation and carbon tax. In general, dispatch of the existing units falls at the higher allowance prices. Capacity factors are less than 60% (except at a $100/tonne carbon tax) versus the 60-62% range at the lower allowance prices (see Figure 31). Capacity factors for new units are shown in Figure 52. This is a combination of NGCC and IGCC technologies. In general, new IGCC units dispatch at a higher capacity factor than new NGCC units. This is shown in Figure 53, which plots capacity factor versus carbon tax for new NGCC and IGCC units at a 0.92% gas price escalation.

The average annual generating cost for existing units is shown in Figure 54. Since most existing units are coal-fired, they are unaffected by gas price escalations. The drop in cost at the $100/tonne carbon tax represents replacement of existing coal-fired units with NGCC systems. In this analysis, replacement units are classified as existing units. For example, 90 existing coal-fired boilers are replaced by NGCC systems at a 0.92% gas price escalation and $100/tonne carbon tax. NGCC systems are more economical under this scenario because of the high carbon tax ($100/tonne).

Average costs for power generation are shown in Figure 55 for new plants. As gas prices escalate, so do power costs.

c) IGCC Technology Cost and Performance

Results of analyses reported in previous sections of this report were based on IGCC cost and performance estimates made by Parsons.[2] The results indicated that, under most plausible scenarios, IGCC market penetration in the ECAR region is significant. Further analyses were performed to determine the threshold at which IGCC market penetration is no longer significant. This was done by increasing the capital cost of advanced IGCC systems or increasing the heat rate, or both. The NOx and allowance prices established in section V.E.3.b. to meet year 2010 emission limits were maintained throughout these analyses. The base case for comparison is the cost and performance values established in the Parsons report.

i) Increase in IGCC Technology Capital Cost

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 56 for a 10% increase in IGCC technology capital costs. Detailed results are shown in Tables 5A, 5B, and 5C. With no carbon tax, the number of IGCC units declines from 38 to 32 units at a 0.92% gas price escala-tion. In addition, 8 advanced supercritical PCs are constructed. At gas price escalations of 2% or greater, the number of IGCC units declines by 6-7 units. No NGCCs are constructed, but 6-7 advanced supercritical PCs are built.

At a $25/tonne carbon tax, there is a decline of IGCC units from 39 to 5 at a 0.92% gas price escalation. These are replaced by 26 NGCC systems and seven advanced supercritical PCs. At gas price escalations of 2.0% and higher, the number of IGCC units declines by 5-7 units. Seven advanced supercritical PCs are constructed at 2% and 3% gas price escalation rates and six at a 4% gas price escalation rate.

At a carbon tax of $50/tonne, only two IGCC units are constructed at a 0.92% gas price escalation. Twenty-four NGCC systems are installed plus seven advanced supercritical PCs. At a gas price escalation of 2.0%, sixteen IGCC systems are built compared with 33 in the base case. Sixteen NGCC systems are installed plus seven advanced supercritical PCs. At 3% and 4% gas price escalations, there is a decline of five and six IGCC units, respectively, compared to the base case.

At a carbon tax of $75/tonne and a 0.92% gas price escalation, the total number of IGCC plants declines from nine to two while the number of NGCC plants constructed increases from 14 to 17. Eight advanced supercritical PCs are added. At a 2% gas price escalation, the number of IGCC units declines from 22 to seven. The number of NGCC units increase by six and eight advanced supercritical PCs are added. At a 3% gas price escalation, 30 IGCC units are constructed versus 34 in the base case. Seven advanced supercritical PCs are also added. At a 4% gas price escalation, IGCC units again decline by five units compared to the base case. Six new advanced supercritical PCs are added.

At a $100/tonne carbon tax, no IGCC units are installed at a 0.92% gas price escalation, and only three units are installed at a 2% gas price escalation. At a 3% gas price escalation, 11 IGCC systems are installed versus 27 in the base case. At a 4% gas price escalation rate, 26 IGCC systems are constructed versus 32 in the base case.

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 57 for a 20% increase in IGCC technology capital costs. Detailed results are shown in Tables 6A, 6B, and 6C. With no carbon tax, no IGCC units are constructed at a 0.92% gas price escalation. New capacity is supplied by 30 NGCC systems. Ten advanced supercritical PCs are also constructed. At gas price escalation of 2%, the number of IGCC declines from 38 to 19 units. No new NGCC units are built, but 19 advanced supercritical PCs are constructed. New capacity is almost evenly divided at a 3% gas price escalation with 20 IGCC and 18 advanced supercritical PCs added. At a 4% gas price escalation and no carbon tax, IGCC units decrease from 38 to 18 units. Twenty-one advanced supercritical PCs are constructed under this scenario also.

At a carbon tax of $25/tonne and a 0.92% gas price escalation, no IGCC units are added. Twenty-nine NGCC systems plus and nine advanced supercritical PCs supply added demand. At a gas price escalation of 2.0%, the number of IGCC units declines from 37 to 13 units. Thirteen advanced supercritical PCs are constructed, along with 14 NGCC systems. At a 3% gas price escalation, IGCC installations decline from 37 to 24 units. IGCC systems dominate new capacity at a 4% gas price escalation rate but the number of units decreases from 37 to 23 units.

At a carbon tax of $50/tonne, no IGCC units are constructed at a 0.92% gas price escalation, compared to eighteen for the base case. Five IGCC systems are constructed at a 2% gas price escalation, a decline of 28 units from the base case. IGCC units regain their dominance at a 3% gas price escalation. Twenty-six IGCC units are constructed, but no NGCC units are added. Thirteen advanced supercritical PCs are also built. At a 4% gas price escalation, IGCC systems total 25 units with 14 advanced supercritical PCs added to satisfy new capacity. No NGCC systems are constructed under this scenario.

At a $75/tonne carbon tax, no IGCC systems are installed for either 0.92% or 2% gas price escalations. NGCC capacity is 17 and 10 units, respectively. The remaining demand is supplied by advanced supercritical PCs, five at the 0.92% escalation rate and eleven at 2% gas price escalation. At a 3% gas price escalation, only eleven IGCC units are constructed versus thirty-four in the base case. These are replaced by 16 NGCC systems and 11 advanced supercritical PCs. One PFBC systems is added. At a 4% gas price escalation, IGCC units capture most new capacity, but their total declines from 36 units in the base case to 23 units. The remaining new capacity is satisfied with 13 advanced supercritical PCs. One PFBC system is added.

At a $100/tonne carbon tax, IGCC units do not achieve market penetration until gas prices escalate to 3%, and then only four units are installed versus the 27 of the base case. At a 0.92% gas price escalation, 104 NGCC systems replace existing coal-fired boilers. This number drops to 46 units at a 2% gas price escalation and 8 at 3% gas price escalation. One existing coal-fired boiler is replaced at the 4% gas price escalation rate. From 1-3 PFBC units are built for gas price escalations in the range of 2-4%. At a 4% gas price escalation, 19 IGCC systems are installed compared to 32 in the base case. Four NGCC systems are added plus 11 advanced supercritical PCs.

Figures 58 through 62 compare technology applications versus carbon tax and gas price escalation.

ii) Increase in IGCC Heat Rate

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 63 for a 10% increase in IGCC technology heat rates. Detailed results are shown in Tables 7A, 7B, and 7C.

With no carbon tax, the number of IGCC units installed is constant over the range of gas price escalations evaluated. The number of IGCC units installed is identical to the base case (39). No NGCC units are constructed.

At a carbon tax of $25/tonne, there is a decline of IGCC units from 41 to 26 at a 0.92% gas price escalation. These are replaced by twelve NGCC systems. At gas price escalations of 2.0% and higher, the number of IGCC units remains nearly identical to the base case.

At a carbon tax of $50/tonne, 11 IGCC units are constructed at a 0.92% gas price escalation versus 22 in the base case. Twenty-six NGCC systems are installed under these conditions including six that replace existing coal-fired boilers. At a gas price escalation of 2.0%, 34 IGCC systems are built compared to 41 in the base case. One PFBC system is constructed, along with five NGCC systems. At 3% and 4% gas price escalations, the number of IGCC units decreases by one unit.

At a $75/tonne carbon tax and a 0.92% gas price escalation, the total number of IGCC plants remains at nine, the same as the base case. At a 2% gas price escalation, the number of IGCC units declines from 26 to 15, while the number of NGCC units increases from 16 to 26. At 3% and 4% gas price escalations, the number of IGCC units remains essentially unchanged.

At a $100/tonne carbon tax, the number of IGCC units installed remains at 4. Under this scenario, 102 coal-fired boilers are replaced with NGCC systems. At a 2% gas price escalation, the number of IGCC systems declines by four. Here, 45 coal-fired boilers are replaced with NGCC systems. At a 3% gas price escalation, IGCC units decrease from 31 to 17 units. The number of IGCC systems installed decreases by one at a 4% gas price escalation compared to the base case.

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 64 for a 20% increase in IGCC technology heat rates. Detailed results are shown in Tables 8A, 8B, and 8C.

With no carbon tax, there is essentially no change in number of IGCC units constructed over the range of gas price escalations evaluated. No other technology supplies new capacity demand.

At a carbon tax of $25/tonne and a 0.92% gas price escalation, the number of IGCC units installed declines from 41 to 15. Twenty-two new NGCC units are built in their place. At 2%, 3%, and 4% gas price escalations, the number of IGCC units constructed remains unchanged compared to the base case.

At a carbon tax of $50/tonne, only eight IGCC units are constructed at a 0.92% gas price escalation compared to 22 for the base case. Nineteen IGCC systems are constructed at a 2% gas price escalation, a decline of 22 units from the base case. IGCC units regain their dominance at higher gas price escalations. Forty-one units are built at 3% and 4% gas price escalations, essentially unchanged from the base case.

At a $75/tonne carbon tax, seven IGCC systems are installed at a 0.92% gas price escalation compared to nine in the base case. At a 2% gas price escalation, 12 IGCC systems are constructed versus 26 in the base case. At a 3% gas price escalation, the number of IGCC systems declines by 18 units. However, at a 4% gas price escalation, the number of IGCC systems installed remains nearly the same as the base case.

At a $100/tonne carbon tax, the number of IGCC units installed remains unchanged at 0.92%, declines by three units at a 2% gas price escalation, declines by 14 units at a 3% gas price escalation, and by 10 units at a 4% gas price escalation.

Figures 65 through 69 compare technology applications versus carbon tax and gas price escalation.

iii) Increase in IGCC Heat Rate and Capital Cost

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 70 for a 5% increase in both IGCC heat rate and capital cost. Detailed results are shown in Tables 9A, 9B, and 9C.

With no carbon tax, the number of IGCC units declines by 3-5 units over a range of gas price escalations of 0.92 to 4%. Three advanced supercritical PCs are built at 0.92 and 2% gas price escalations and two at 3% and 4% gas price escalations. No NGCC units are constructed.

At a carbon tax of $25/tonne, there is a decline of IGCC units from 41 to 16 at a 0.92% gas price escalation. These are replaced by 19 NGCC systems and three advanced supercritical PCs. At gas price escalations of 2.0% and higher, the number of IGCC units declines by 3-4 units. Again, three advanced supercritical PCs are built at 0.92 and 2% gas price escalations and two at 3% and 4% gas price escalations.

At a carbon tax of $50/tonne, seven IGCC units are constructed at a 0.92% gas price escalation versus 22 in the base case. Twenty-nine NGCC systems are installed under these conditions. At a gas price escalation of 2.0%, 30 IGCC systems are built compared to 41 in the base case. One PFBC system is constructed, along with six NGCC systems and three advanced supercritical PCs. At 3% and 4% gas price escalations, IGCC units decline by 1-4 units, but dominate new capacity construction. No NGCC units are constructed at these gas price escalations.

At a carbon tax of $75/tonne and a 0.92% gas price escalation, the total number of IGCC plants decreases from nine to seven. At a 2% gas price escalation, the number of IGCC units declines from 26 to 14, while the number of NGCC units increases from 16 to 24. At 3% and 4% gas price escalations, IGCC units dominate new capacity, although there is a small decline in the number of units compared to the base case.

At a carbon tax of $100/tonne, the number of IGCC units installed remains unchanged at a 0.92% gas price escalation, declines by four units at a 2% gas price escalation, declines by 13 units at a 3% gas price escalation, and by only one unit at a 4% gas price escalation.

A plot of IGCC market penetration versus gas price escalation and carbon tax is shown in Figure 71 for a 10% increase in both IGCC heat rate and capital cost. Detailed results are shown in Tables 10A, 10B, and 10C.

With no carbon tax, the number of IGCC units declines by 14 units at a 0.92% gas price escalation, by 10 units at 2% and 3% gas price escalations, and by 11 units at a 4% gas price escalation. While five NGCC systems are built at the 0.92% gas price escalation, advanced supercritical units begin to capture a significant portion of the new capacity installation. Between eight and ten units are added over the 0.92 - 4% gas price escalation range.

At a $25/tonne carbon tax, there is a decline of IGCC units from 41 to only 2 units at a 0.92% gas price escalation. These are replaced primarily by NGCC systems, but eight advanced supercritical PCs also are added. At a gas price escalations of 2.0%, the number of IGCC units declines by 10 units. No NGCC systems are constructed but ten advanced supercritical PCs also are built. At a 3% gas price escalation, the number of IGCC units decreases by 11 units and are replaced with nine advanced supercritical PCs. The number of IGCC systems installed at a 4% gas price escalation decreases by ten units and they are replaced with ten advanced supercritical PCs. No NGCC systems are added.

At a carbon tax of $50/tonne, only one IGCC unit is constructed at a 0.92% gas price escalation versus 22 in the base case. Thirty NGCC systems are installed under these conditions, up from 21 in the base case. Eight advanced supercritical PCs are also added. At a gas price escalation of 2.0%, ten IGCC systems are built compared to 41 in the base case. Eight advanced supercritical PCs are added along with one PFBC system and 20 NGCC units. At a 3% gas price escalation, IGCC systems decrease by 11 units and they are replaced by ten advanced supercritical PCs and one pressurized fluidized bed combustor. At a 4% gas price escalation, IGCC units predominate but decline by 12 units compared to the base case. Eight advanced supercritical PCs are added plus one pressurized fluidized bed combustor. No NGCC units are built.

At a carbon tax of $75/tonne and a 0.92% gas price escalation, the total number of IGCC plants decreases from nine to two. Four advanced supercritical PCs are added. The number of NGCC systems added remains at 46. At a 2% gas price escalation, the number of IGCC units declines from 26 to seven while the number of NGCC units increases from 16 to 25. Nine advanced supercritical PCs are added. At a 3% gas price escalation, the number of IGCC decreases from 42 to 16 units while 14 NGCC systems, nine advanced supercritical PCs, and one pressurized fluidized bed combustor are added. At a 4% gas price escalation, IGCC systems decreases from 44 to 30 units and are replaced with nine advanced supercritical PCs and one pressurized fluidized bed combustor.

At a carbon tax of $100/tonne, IGCC systems decline by four units at a 0.92% gas price escalation, by eight units at a 2% gas price escalation, by 23 units at a 3% gas price escalation and by 18 units at a 4% gas price escalation.

With a 20% increase in both IGCC capital cost and heat rate, IGCCs are no longer competitive with NGCC systems. Even under the best scenario, 4% gas price escalation and no carbon tax, only seven IGCC systems are installed. However, thirty-one advanced supercritical coal-fired systems are installed, demonstrating that the cost advantage of coal maintains it as a viable fuel source.

Figures 72 through 76 compare technology applications versus carbon tax and gas price escalation.

VI. CASE HISTORIES

To illustrate the selection process used by the CONSOL RCM for retrofitting or replacing existing coal-fired boilers and adding new generation capacity, several examples are presented here. These examples show the data that were used in the decision process for specific scenarios. The technologies considered for retrofit and replacement of existing boilers and for addition of new capacity are described in section V.C. Compliance Options. Since the retrofit, replacement, and repowering options are designed for discrete power outputs, they generally do not match the size and power output of an existing unit. Any shortfalls or excesses in power created when these units are installed are balanced by changes in other plants in the ECAR region.

Economies of scale obviously impact economics but this analysis is based on the specific designs and costs available from Reference 2. Those designs were developed to match efficient gas and steam turbine sizes expected to be available in the time frame evaluated.

Allowance prices were set at $800/ton for sulfur dioxide emissions and $1500/ton (year-round) for NOx emissions for each of the case histories shown below. These allowance prices were applied to all stack emissions, even if emissions control equipment was already in place.

The capacity factors shown for each case are based on the optimum dispatch of the lowest cost power generation technology. Performance and cost parameters are shown for a single plant in each illustration. However, the dispatch rate of any single boiler is a function of all the plants in the ECAR system. Thus, the capacity factor is not solely a function of the unit illustrated but rather of the dispatch of all of the boilers in the ECAR region.

A. <u>Allowance Purchase</u>

The first example illustrates a case where the lowest cost compliance strategy is the purchase of emissions allowances. In this example, the carbon tax is $100/tonne and the gas price escalation rate is 0.92%/yr.

The results from an evaluation of the Pleasants Unit 1 boiler are shown in Table 11. This boiler has existing low-NOx burners (LNB) with overfire air for NOx control and a flue gas desulfurization (FGD) system for sulfur dioxide control. Since the unit already has NOx controls, the only technologies evaluated for further NOx reduction were selective non-catalytic reduction (SNCR), selective catalytic reduction (SCR), coal reburn, and gas reburn. No technology retrofits were considered for sulfur dioxide reduction since the unit already has an FGD system.

The power cost for each technology retrofit option is compared against the purchase of allowances ("as-is"). For the conditions evaluated, the lowest power cost is achieved with the purchase of allowances ($45.30/MWh). This is then set as the most economical compliance option for the existing boiler for comparison to repowering and replacement options.

On the bottom of Table 11, the power cost of the most economical existing system is compared to repowering and replacement options. Because the existing steam turbine is not compatible with the potential repowering technolo-gies (i.e., NGCC, IGCC, PFBC), repowering is not a viable option for this particular plant.

The replacement options considered in Table 11 are conversion of the existing coal-fired boiler to natural gas, replacing the entire unit with an H turbine NGCC system, and replacing with an advanced air blown IGCC system. In reality, other options were considered, but only the lowest cost gas and coal systems are shown in Table 11. A complete listing is shown in later case histories.

The results shown on the bottom of Table 11 indicate that the existing system with purchase of allowances ("as-is") represents the lowest power generation cost at this plant for the fuel prices and carbon tax used in the evaluation.

B. <u>Technology Retrofit</u>

A second example illustrates a condition where retrofitting control technology is the lowest cost compliance option for a particular boiler. In this example, the carbon tax is $100/tonne and the gas price escalation rate is 0.92%/yr.

The results of an evaluation of the Spurlock Unit 2 boiler are shown in Table 12. This boiler has existing low NOx Burners with overfire air for NOx control and an FGD system for sulfur dioxide control. Since the unit already has NOx controls, the only technologies evaluated for further NOx reduction were SNCR, SCR, coal reburn, and gas reburn. Since the existing unit configuration includes an FGD system, no further sulfur dioxide reduction technology retrofits were considered.

The power cost for each technology retrofit option is compared against the purchase of allowances. For the conditions evaluated, the lowest power cost is achieved by installing an SCR control system for further NOx control. With the SCR retrofit, the power generation cost is $48.98/MWh compared to $52.80/MWh if allowances are purchased. This then is set as the most economical compliance option for the existing boiler.

On the bottom half of Table 12, the power cost for the most economical existing system is compared against repowering and replacement options. Because the existing steam turbine of the Spurlock Unit 2 boiler is not compatible with potential repowering technologies, repowering is not a viable option for this particular plant.

The replacement options shown in Table 12 are conversion of the existing boiler to natural gas, replacing with an H turbine NGCC system, and replacing with an advanced air blown IGCC system. While a much larger set of new capacity options were considered, only the most economical coal and gas replacements are shown for clarity in Table 12.

The power costs for the replacement options are higher than the power costs for retrofitting the existing boiler with an SCR system. Therefore, retrofitting the existing boiler with an SCR system is the most economical option for producing power from this boiler for the conditions specified.

C. Boiler Replacement

A third example illustrates a case in which replacement of an existing boiler is the most economical power generation option for a $100/tonne carbon tax and a 0.92%/yr gas price escalation rate. The Hatfields Ferry Unit 1 boiler was used for this example. This unit currently has low-NOx burners for NOx control but does not have sulfur dioxide emissions controls. Power generation costs for the purchase of emission allowances and for various retrofit options are shown on the top of Table 13. For the conditions evaluated, retrofitting the existing boiler with overfire air for additional NOx control and an FGD system for sulfur dioxide control is the lowest cost compliance option.

This compliance option is compared against power costs for replacement technologies at the bottom of Table 13. A new H turbine NGCC system has the lowest power costs. Thus, the existing boiler Unit 1 boiler at Hatfields Ferry would be replaced with this NGCC system.

D. Repowering

This example illustrates a case where repowering the existing boiler represents the lowest cost emissions compliance strategy. Generally, the term "repowering" means the replacement of the original unit steam supply system and integration of the new steam system into the remainder of the plant. The steam turbine-generator is the most critical item reused. The reuse of other plant systems is maximized. Some systems may require upgrading or refurbishment. This study provided an initial and limited evaluation of the repowering option, because the evaluation of repowering is very site specific and very limited information on performance and cost is available.

Data generated for Unit 5 of the Burger power station are shown in Table 14. This unit does not have existing NOx or sulfur dioxide emission control equipment (as of 1997). In this example, the carbon tax was set at $100/tonne and the gas price escalation rate at 4.0%/yr.

For the existing boiler, installation of low NOx burners with overfire air along with an FGD system for sulfur dioxide emissions reduction represents the lowest cost option for power generation. The cost and performance data for the retrofit options evaluated in this example are shown on the top of Table 14.

Repowering and replacement options are shown on the bottom of Table 14. For this boiler, the existing steam turbine rating matches the turbine rating of the PFBC technology option. For the conditions evaluated, the PFBC option provides the lowest cost power generation when compared to the most economical existing boiler options and other replacement options.

E. New Capacity Options - New Gas

In the first four examples, only the lowest cost gas and coal technologies were shown as replacement candidates. In fact, many other technologies were evaluated. These are shown in Table 15, where the costs of new power generation options are shown for the Pleasants power station. Since new capacity is being evaluated, the station selection is not relevant, except that it establishes the delivered coal price (which varies for each station in the ECAR region) used in the analysis. For this example, the carbon tax is \$100/tonne and the gas price escalation rate is 0.92%/yr. This analysis shows that, for the assumed parameters, the lowest power generation cost for new capacity is satisfied by the H turbine NGCC system.

F. New Capacity Options - New Coal

A similar analysis was performed for the Burger station at a \$100/tonne carbon tax and 4.0 %/yr gas price escalation rate. In this scenario (Table 16), the lowest cost power generation option is the advanced air blown IGCC system.

VII. CARBON DIOXIDE EMISSIONS

In most of the scenarios considered in the evaluations reported here, a carbon tax was applied in \$25/tonne increments to determine its impact on IGCC deployment in particular and its impact on technology applications for new power generation in general. These taxes were applied because of their possible imposition at some time in the relatively near future to mitigate carbon dioxide emissions to the atmosphere and its apparent effect on global warming.

While technologies were added to generate the lowest marginal cost of electricity, natural gas and advanced coal based technologies are inherently lower emitters of carbon dioxide compared to conventional PC units. Therefore, when these technologies are installed to meet added demand or replace inefficient existing boilers, the level of carbon dioxide emitted per unit of electricity generated decreases.

The carbon dioxide emissions of each technology evaluated are shown below in terms of pounds emitted per megawatt of power generated.

Technology	Carbon Dioxide Emissions, lb/MWh
Existing Coal Fired Boiler	2050 (10,000 Btu/kWh Heat Rate)
Existing Boiler Conversion to Gas	1200
FA Gas Turbine NGCC (current)	830
G Gas Turbine NGCC (advanced)	760
H Gas Turbine (advanced)	721
Advanced Ultra Supercritical PC	1696
PFBC	1492

Advanced Air IGCC	1480
Advanced Oxygen IGCC	1501

Clearly, gas fueled technologies generate lower carbon dioxide emissions. However, carbon taxes applied in this analysis provide a quantifiable economic benefit of lowering carbon dioxide emissions. Despite the imposition of carbon taxes, advanced IGGC systems remain economically competitive except at very low gas price escalations and very high carbon taxes.

Figure 77 is a plot of carbon dioxide emissions in 2010 versus gas price escalation and carbon tax for the base case allowance prices. This plot is predicated on power generation requirements in 2010. Thus, the same number of MWh is generated in each case, albeit with different technology combinations.

If a 0.92% gas price escalation and no carbon tax are established as the business-as-usual (BAU) condition, then carbon dioxide emission reductions are only significant (i.e., >10% of BAU) at a 0.92% gas price escalation with carbon taxes of $75/tonne or greater, and at a 2% gas price escalation combined with a $100/tonne carbon tax. This figure corresponds fairly closely to Figure 78, which shows IGCC market penetration versus gas price escalation and carbon tax. In essence, carbon dioxide emissions can be decreased significantly only if coal-fired systems are replaced by gas-fired technologies. However, this cannot be economically justified in most cases.

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3) Energy Information Administration (EIA) Annual Energy Outlook 2000, DOE/EIA-0383, December 1999.

Table 1A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Fully Advanced IGCC
Breakdown by Number of Plants

NOx Allowance Price ($/ton, Ozone Season) = 1723 NOx Allowance Price ($/ton, Non-Ozone Season) = 259 SOx Allowance Price ($/ton) = 354

IGCC Development Level	Fully Developed				Fully Developed				Fully Developed				Fully Developed				Fully Developed			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,140	96,141	96,142	96,142	96,140	96,141	96,142	96,142	96,140	96,141	96,142	96,142	96,480	96,141	96,142	96,142	101,663	96,494	96,297	96,300
Total New Capacity Required, MW	12,342	12,342	12,342	12,342	12,740	13,138	12,740	12,740	13,086	13,138	13,138	13,138	13,082	13,107	13,138	13,138	9,107	13,092	13,536	13,536
Total Region Capacity Installed, MW	108,482	108,483	108,484	108,484	108,881	109,280	108,882	108,882	109,226	109,280	109,280	109,280	109,562	109,249	109,280	109,280	110,771	109,586	109,833	109,836
Overall Compliance Strategies																				
As-Is, Buy Allowances	24	23	22	23	25	26	26	26	29	28	27	27	31	34	33	33	37	40	40	40
Retrofit Existing Plant	266	267	268	267	265	264	264	264	260	262	263	263	253	255	257	257	212	243	250	250
Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	4	1	0	0	10	3	0	0
Retirements	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	31	4	0	0
Replacement With New Gas	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	31	4	0	0
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Capacity-Gas	0	0	0	0	0	0	0	0	17	0	0	0	18	10	0	0	16	15	0	0
Additional Capacity-Coal	31	31	31	31	32	32	32	32	16	33	33	33	15	23	33	33	7	18	34	34
Total Plants	321	321	321	321	322	322	322	322	323	323	323	323	323	323	323	323	313	323	324	324
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	31	4	0	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	31	4	0	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	31	4	0	0
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	4	1	0	0	10	3	0	0
FGD	10	10	10	10	10	10	10	10	10	10	10	10	8	10	10	10	0	6	10	10
LNB	86	86	85	85	93	93	92	92	94	96	96	96	91	92	93	93	89	93	96	96
LNB/OFA	149	150	152	151	143	142	143	143	139	139	139	139	138	139	139	139	109	134	137	137
SNCR	2	2	2	1	2	2	2	1	2	2	2	1	3	2	1	1	2	2	1	1
SCR	6	5	4	4	6	5	4	4	6	5	4	4	5	5	4	4	4	4	4	4
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	17	0	0	0	18	10	0	0	16	15	0	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	31	31	31	31	32	32	32	32	16	33	33	33	15	23	33	33	7	18	34	34
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	17	0	0	0	18	10	0	0	16	15	0	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	31	31	31	31	32	32	32	32	16	33	33	33	15	23	33	33	7	18	34	34
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	31	31	31	31	32	32	32	32	33	33	33	33	33	33	33	33	23	33	34	34

Table 1B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Fully Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)

NOx Allowance Price ($/ton, Ozone Season) = 1723 NOx Allowance Price ($/ton, Non-Ozone Season) = 259 SOx Allowance Price ($/ton) = 354

IGCC Development Level	Fully Developed				Fully Developed				Fully Developed				Fully Developed				Fully Developed			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Fossil Capacity, MW	96,140	96,141	96,142	96,142	96,140	96,141	96,142	96,142	96,140	96,141	96,142	96,142	96,480	96,141	96,142	96,142	101,663	96,494	96,297	96,300
Total New Capacity Required, MW	12,342	12,342	12,342	12,342	12,740	13,138	12,740	12,740	13,086	13,138	13,138	13,138	13,082	13,107	13,138	13,138	9,107	13,092	13,536	13,536
Total Region Capacity Installed, MW	108,482	108,483	108,484	108,484	108,881	109,280	108,882	108,882	109,226	109,280	109,280	109,280	109,562	109,249	109,280	109,280	110,771	109,586	109,833	109,836
Overall Compliance Strategies																				
Existing Non-Fossil	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,885	11,870	11,885	11,885	11,885	11,678	11,843	11,884	11,884
As-Is, Buy Allowances	3,659	4,840	3,540	3,596	4,188	5,488	4,296	4,296	5,094	5,031	4,557	4,557	5,711	6,957	6,229	6,177	8,720	8,795	8,743	8,722
Retrofit Existing Plant	80,596	79,416	80,716	80,660	80,067	78,768	79,960	79,960	79,064	79,225	79,699	79,699	77,535	77,202	78,027	78,079	64,125	74,009	75,669	75,694
Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	574	98	0	0	4,895	267	0	0
Retirements	0	0	0	0	0	0	0	0	0	0	0	0	790	0	0	0	12,246	1,580	0	0
Replacement With New Gas	0	0	0	0	0	0	0	0	0	0	0	0	790	0	0	0	12,246	1,580	0	0
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repower	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Capacity-Gas	0	0	0	0	0	0	0	0	6,715	0	0	0	7,110	3,950	0	0	6,320	5,925	0	0
Additional Capacity-Coal	12,342	12,342	12,342	12,342	12,740	12,740	12,740	12,740	6,370	13,138	13,138	13,138	5,972	9,157	13,138	13,138	2,787	7,166	13,536	13,536
Total Capacity, Fossil Technologies	96,597	96,598	96,598	96,598	96,995	96,996	96,997	96,997	97,341	97,394	97,395	97,395	96,903	97,364	97,395	97,395	86,847	96,163	97,949	97,952
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	0	0	0	0	790	0	0	0	12,246	1,580	0	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	0	0	0	0	790	0	0	0	12,246	1,580	0	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	0	0	0	0	0	0	0	790	0	0	0	12,246	1,580	0	0
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	574	98	0	0	4,895	267	0	0
FGD	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,950	2,509	2,950	2,950	2,950	0	1,763	3,106	3,109
LNB	14,168	14,073	13,993	14,017	15,271	15,271	15,163	15,163	14,887	15,047	15,047	15,047	13,618	13,703	13,747	13,799	14,003	13,880	14,197	14,218
LNB/OFA	51,790	50,704	52,084	52,004	51,272	49,972	51,272	51,272	51,401	51,401	51,401	51,401	52,182	52,383	52,383	52,383	44,227	52,338	53,286	53,286
SNCR	1,010	1,010	1,010	750	1,010	1,010	1,010	750	1,010	1,010	1,010	750	1,607	1,010	750	750	1,010	1,010	750	750
SCR	2,747	2,118	1,815	1,815	2,747	2,118	1,815	1,815	2,747	2,118	1,815	1,815	2,118	2,118	1,815	1,815	1,519	1,815	1,815	1,815
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6,715	0	0	0	7,110	3,950	0	0	6,320	5,925	0	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	12,342	12,342	12,342	12,342	12,740	12,740	12,740	12,740	6,370	13,138	13,138	13,138	5,972	9,157	13,138	13,138	2,787	7,166	13,536	13,536
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6,715	0	0	0	7,110	3,950	0	0	6,320	5,925	0	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	12,342	12,342	12,342	12,342	12,740	12,740	12,740	12,740	6,370	13,138	13,138	13,138	5,972	9,157	13,138	13,138	2,787	7,166	13,536	13,536
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	12,342	12,342	12,342	12,342	12,740	12,740	12,740	12,740	13,086	13,138	13,138	13,138	13,082	13,107	13,138	13,138	9,107	13,092	13,536	13,536

Table 1C. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Fully Advanced IGCC

NOx Allowance Price ($/ton, Ozone Season) = 1723
NOx Allowance Price ($/ton, Non-Ozone Season) = 259

SOx Allowance Price ($/ton) = 354

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	31	32	16	15	7	31	32	33	23	18
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	2	31	0	0	0	0	4
New Capacity-Gas	0	0	17	18	16	0	0	0	10	15
Total of above	31	32	33	35	54	31	32	33	33	37
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	12,342	12,740	6,370	5,972	2,787	12,342	12,740	13,138	9,157	7,166
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	790	12,246	0	0	0	0	1,580
New Capacity-Gas	0	0	6,715	7,110	6,320	0	0	0	3,950	5,925
Total of above	12,342	12,740	13,086	13,872	21,353	12,342	12,740	13,138	13,107	14,672

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	31	32	33	33	34	31	32	33	33	34
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	0	0	0	0	0	0	0
New Capacity-Gas	0	0	0	0	0	0	0	0	0	0
Total of above	31	32	33	33	34	31	32	33	33	34
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	12,342	12,740	13,138	13,138	13,536	12,342	12,740	13,138	13,138	13,536
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	0	0	0	0	0	0	0
New Capacity-Gas	0	0	0	0	0	0	0	0	0	0
Total of above	12,342	12,740	13,138	13,138	13,536	12,342	12,740	13,138	13,138	13,536

Table 2A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Fully Advanced IGCC
Breakdown by Number of Plants

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Fully Advanced IGCC				Fully Advanced IGCC				Fully Advanced IGCC				Fully Advanced IGCC				Fully Advanced IGCC			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
NOx Allowance ($/ton, Ozone Season)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
NOx Allowance ($/ton, Non-Ozone Season)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SOx Allowance ($/ton)	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,038	96,037	96,033	96,033	96,350	96,612	96,648	96,648	98,130	98,477	97,915	97,916	102,860	99,004	98,160	98,161	106,874	103,358	99,164	98,475
Total New Capacity Required, MW	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	13,487	13,138	13,934	13,934	9,114	12,709	13,536	14,333	5,148	7,533	11,935	12,740
Total Region Capacity Installed, MW	111,166	111,165	111,162	111,162	111,877	111,343	111,378	111,379	111,617	111,615	111,850	111,851	111,974	111,713	111,696	112,493	112,022	110,892	111,099	111,215
Overall Compliance Strategies																				
As-Is, Buy Allowances	25	24	24	23	24	23	25	25	23	23	25	25	22	23	25	25	20	24	24	25
Retrofit Existing Plant	263	265	265	266	263	265	262	262	253	257	257	257	225	251	256	256	161	215	251	255
Fuel Switch	1	0	0	0	1	0	0	0	5	1	0	0	11	4	0	0	19	5	2	0
Retirements	1	1	1	1	2	2	3	3	5	4	3	3	32	6	4	4	90	46	7	5
Replacement With New Gas	0	0	0	0	0	0	0	0	5	0	0	0	32	6	0	0	90	46	7	0
Replacement With New Coal	1	1	1	1	2	2	3	3	0	4	3	3	0	0	4	4	0	0	0	5
Repower	0	0	0	0	0	0	0	0	4	5	5	5	0	6	5	5	0	0	5	5
Additional Capacity-Gas	0	0	0	0	0	0	0	0	16	0	0	0	14	10	0	0	9	10	3	0
Additional Capacity-Coal	38	38	38	38	39	37	37	37	18	33	35	35	9	22	34	36	4	9	27	32
Total Plants	328	328	328	328	329	327	327	327	324	323	325	325	313	322	324	326	303	309	319	322
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	5	0	0	0	32	6	0	0	90	46	7	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	1	1	1	1	2	2	3	3	0	4	3	3	0	0	4	4	0	0	0	5
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	5	0	0	0	32	6	0	0	90	46	7	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	1	1	1	1	2	2	3	3	0	4	3	3	0	0	4	4	0	0	0	5
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	1	1	1	1	2	2	3	3	5	4	3	3	32	6	4	4	90	46	7	5
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	1	0	0	0	2	0	0	0	8	0	0	0	17	1	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	3	1	0	0	3	4	0	0	2	4	2	0
FGD	74	75	77	77	74	76	72	72	66	69	67	67	46	67	66	66	4	29	63	62
LNB	73	74	74	74	78	78	75	74	72	75	76	74	61	70	75	75	51	63	69	69
LNB/OFA	151	156	157	158	146	151	154	155	143	144	147	150	124	142	146	148	86	121	146	153
SNCR	26	26	24	22	24	25	25	22	26	27	24	23	25	26	25	23	11	20	24	24
SCR	28	28	29	29	29	30	29	29	25	27	24	25	21	25	25	25	8	18	23	22
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	4	4	4	4	0	4	4	4	0	0	4	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	16	0	0	0	14	10	0	0	9	10	3	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	38	38	38	38	38	37	37	37	18	33	35	35	9	22	34	36	4	9	27	32
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	16	0	0	0	14	10	0	0	9	10	3	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	38	38	38	38	38	37	37	37	18	33	35	35	9	22	34	36	4	9	27	32
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	38	38	38	38	38	37	37	37	34	33	35	35	23	32	34	36	13	19	30	32

Table 2B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Fully Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Fully Advanced IGCC				Fully Advanced IGCC				Fully Advanced IGCC				Fully Developed				Fully Advanced IGCC			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
NOx Allowance ($/ton, Ozone Season)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
NOx Allowance ($/ton, Non-Ozone Season)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
SOx Allowance ($/ton)	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,038	96,037	96,033	96,033	96,350	96,612	96,648	96,648	98,130	98,477	97,915	97,916	102,860	99,004	98,160	98,161	106,874	103,358	99,164	98,475
Total New Capacity Required, MW	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	13,487	13,138	13,934	13,934	9,114	12,709	13,536	14,333	5,148	7,533	11,935	12,740
Total Region Capacity Installed, MW	111,166	111,165	111,162	111,162	111,877	111,343	111,378	111,379	111,617	111,615	111,850	111,851	111,974	111,713	111,696	112,493	112,022	110,892	111,099	111,215
Overall Compliance Strategies																				
Existing Non-Fossil	12,267	12,267	12,267	12,267	12,665	12,665	13,025	13,025	13,428	15,395	14,997	14,997	11,731	14,246	15,395	15,395	11,386	11,610	14,184	15,790
As-Is, Buy Allowances	2,606	2,021	2,498	1,913	1,766	1,663	2,116	2,116	1,663	1,663	2,116	2,116	1,577	1,663	2,116	2,116	1,988	2,277	2,277	2,412
Retrofit Existing Plant	81,028	81,749	81,269	81,853	81,782	82,284	81,507	81,507	80,598	81,350	80,803	80,804	75,453	80,388	80,649	80,650	53,392	70,828	79,798	80,273
Fuel Switch	136	0	0	0	136	0	0	0	466	69	0	0	1,458	337	0	0	4,555	473	141	0
Retirements	398	398	398	398	796	796	1,194	1,194	1,975	1,593	1,194	1,194	12,641	2,370	1,593	1,593	35,552	18,171	2,765	1,991
Replacement With New Gas	0	0	0	0	0	0	0	0	1,975	0	0	0	12,641	2,370	0	0	35,552	18,171	2,765	0
Replacement With New Coal	398	398	398	398	796	796	1,194	1,194	0	1,593	1,194	1,194	0	0	1,593	1,593	0	0	0	1,991
Repower	0	0	0	0	0	0	0	0	1,593	1,972	1,972	1,972	0	2,383	1,972	1,972	0	0	2,367	1,972
Additional Capacity-Gas	0	0	0	0	0	0	0	0	6,320	0	0	0	5,530	3,950	0	0	3,555	3,950	1,185	0
Additional Capacity-Coal	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	7,166	13,138	13,934	13,934	3,583	8,759	13,536	14,333	1,593	3,583	10,749	12,740
Total Capacity	98,899	98,898	98,895	98,895	99,211	98,677	98,353	98,354	97,806	98,192	98,825	98,826	87,602	97,480	98,273	99,070	65,083	81,110	96,516	97,397
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	1,975	0	0	0	12,641	2,370	0	0	35,552	18,171	2,765	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	398	398	398	398	796	796	1,194	1,194	0	1,593	1,194	1,194	0	0	1,593	1,593	0	0	0	1,991
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	1,975	0	0	0	12,641	2,370	0	0	35,552	18,171	2765.19	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	398	398	398	398	796	796	1,194	1,194	0	1,593	1,194	1,194	0	0	1592.51	1592.51	0	0	0	1,991
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	398	398	398	398	796	796	1,194	1,194	1,975	1,593	1,194	1,194	12,641	2,370	1,593	1,593	35,552	18,171	2,765	1,991
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	136	0	0	0	227	0	0	0	1,191	0	0	0	4,246	136	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	239	69	0	0	267	337	0	0	309	336	141	0
FGD	26,315	26,447	26,637	26,637	26,546	27,038	26,166	26,166	25,495	26,173	25,463	25,462	21,602	25,563	25,309	25,309	1,526	13,967	24,929	22,427
LNB	8,378	8,127	7,808	8,031	9,479	8,533	8,129	7,744	8,139	8,359	8,757	7,574	6,708	8,118	8,207	7,740	4,535	5,622	6,729	6,262
LNB/OFA	56,755	58,503	58,410	58,772	56,413	58,436	58,646	59,031	56,636	57,169	57,112	58,498	52,767	56,381	57,321	58,178	40,899	51,443	57,974	59,575
SNCR	14,074	13,631	12,762	11,700	13,355	13,753	13,390	12,073	13,965	15,265	12,875	12,328	14,337	14,750	14,175	12,328	7,552	12,136	13,628	13,661
SCR	11,836	10,777	10,861	10,861	12,148	11,206	11,039	11,039	11,610	11,098	10,125	10,365	9,651	10,948	10,763	10,803	4,297	9,063	10,466	10,207
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	1,593	1,593	1,593	1,593	0	1,593	1,593	1,593	0	0	1,593	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6,320	0	0	0	5,530	3,950	0	0	3,555	3,950	1,185	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	7,166	13,138	13,934	13,934	3,583	8,759	13,536	14,333	1,593	3,583	10,749	12,740
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6,320	0	0	0	5,530	3,950	0	0	3,555	3,950	1,185	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	7,166	13,138	13,934	13,934	3,583	8,759	13,536	14,333	1,593	3,583	10,749	12,740
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,129	15,129	15,129	15,129	15,527	14,731	14,731	14,731	13,487	13,138	13,934	13,934	9,114	12,709	13,536	14,333	5,148	7,533	11,935	12,740

Table 2C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S. Fully Advanced IGCC

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500

SOx Allowance Price ($/ton) = 800

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	1	2	4	0	0	1	2	8	4	0
New Capacity-IGCC	38	38	18	9	4	38	37	33	22	9
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	5	32	90	0	0	0	6	46
New Capacity-Gas	0	0	16	14	9	0	0	0	10	10
Total of above	39	40	43	55	103	39	39	42	42	65
Installed Capacity, MW gross										
Replacement Plants-IGCC	398	796	1,593	0	0	398	796	3,185	1,593	0
New Capacity-IGCC	15,129	15,129	7,166	3,583	1,593	15,129	14,731	13,138	8,759	3,583
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	1,975	12,641	35,552	0	0	0	2,370	18,171
New Capacity-Gas	0	0	6,320	5,530	3,555	0	0	0	3,950	3,950
Total of above	15,527	15,925	17,054	21,754	40,700	15,527	15,527	16,324	16,672	25,705

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	1	3	7	8	4	1	3	7	8	9
New Capacity-IGCC	38	37	35	34	27	38	37	35	36	32
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	0	7	0	0	0	0	0
New Capacity-Gas	0	0	0	0	3	0	0	0	0	0
Total of above	39	40	43	43	42	39	40	43	45	42
Installed Capacity, MW gross										
Replacement Plants-IGCC	398	1,194	2,787	3,185	1,593	398	1,194	2,787	3,185	3,583
New Capacity-IGCC	15,129	14,731	13,934	13,536	10,749	15,129	14,731	13,934	14,333	12,740
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	0	2,765	0	0	0	0	0
New Capacity-Gas	0	0	0	0	1,185	0	0	0	0	0
Total of above	15,527	15,925	16,722	16,722	16,293	15,527	15,925	16,722	17,519	16,324

Table 3. IGCC Market Penetration Study - Technologies Evaluated
ECAR Region

Title	Subcritical PC	Supercritical PC	Ultra SuperC PC	Adv Ultra SuperC PC	IGCC	IGCC	IGCC	IGCC
SubTitle					First-of-Kind	Intermediate	Advanced	Advanced
Capacity (MWe)	397	402	399	398	543	349	398	428
Pressure (psig)	Balanced Draft	Balanced Draft	Balanced Draft	Balanced Draft	400	500	475	500
Gas Turbine Type	N/A	N/A	N/A	N/A	GE MS	W G	GE H	GE H
Firing Mode	Wall/Dry Bottom	Wall/Dry Bottom	Wall/Dry Bottom	Wall/Dry Bottom	Oxygen Blown	Oxygen Blown	Air Blown	Oxygen Blown
NPHR (Btu/kWh)	9,077	8,568	8,251	8,266	8,522	7,514	6,870	6,969
Availability	Now	2000	2010	2010	2001	2005	2010	2010
NOx Control	LNB/OFA	LNB/OFA/SCR	LNB/OFA/SNCR		Comb Staging	Comb Staging	Comb Staging	Comb Staging
NOx Emissions (lb/MWh)	4.09	1.35	1.35	0.45	0.21	0.182	0.16	0.167
FGD Type	LSFO	LSFO	LSFO	LSFO	AGR	THGD	THGD	THGD
SOx Emissions (lb/MWh)	3.13	1.47	1.42	1.40	0.48	0.13	0.12	0.12
SO_2 Rem (%)	92	96	96	95	99	99.5	99.5	99.5
CO_2 Emissions (lb/MWh)	1846	1740	1679	1696	1708	1506	1376	1396
FGD Slud Disp	Gyp Stacking	Gyp Stacking	Gyp Stacking	Gyp Stacking				
Particulate Rem	ESP	FF	FF	FF	Ceramic CF	Ceramic CF	Ceramic CF	Ceramic CF
Byproduct Sales					H_2SO_4	H_2SO_4	H_2SO_4	H_2SO_4
Capial Cost ($/kW)	1129	1173	1170	1023	1241	1229	961	1087

Title	Current	Adv PFBC	NGCC	NGCC	NGCC	High Coal CoCc	High Gas CoCo
SubTitle	BPFBC		Current	W G	GE H		
Capacity (MWe)	425	379	239	326	395	460	428
Pressure (psig)		340					
Gas Turbine Type		W G	FA	W G	GE H		
Firing Mode	Air Blown	Air Blown	Air Blown	Air Blown	Air Blown		
NPHR (Btu/kWh)	8354	7269	7359	6743	6396	11721	9258
Availability	2001	Now	Now	Now	Now		
NOx Control	Comb Staging	Comb Staging	Intinsic	Intinsic	Intinsic		
NOx Emissions (lb/MWh)	0.38	0.725	0.86	0.202	0.192	0.1	0.06
FGD Type	In Bed/$CaSO_4$	In Bed/$CaSO_4$	Intinsic	Intinsic	Intinsic		
SOx Emissions (lb/MWh)	1.91	1.67	0	0	0	0.03	0.02
SO_2 Rem (%)	95	95	N/A	N/A	N/A	98	98
CO_2 Emissions (lb/MWh)	1719	1496	830	796	754	1595	1107
FGD Slud Disp							
Particulate Rem		Ceramic CF	N/A	N/A	N/A		
Byproduct Sales						Liq. Fuels	Liq. Fuels
Capial Cost ($/kW)	1190	1001	687	524	461	1511	1136

AGR Amine Based Acid Gas Recovery
THGD Transport Hot Gas Desulfurizer (Zn Based Sorbent)

TABLE 4

FINANCIAL FACTORS AND CONSTRUCTION PERIODS

Financial Factors	
ROI, %	15.00%
Project Life, years	26-28
Construction Period, years	1-3
Operating Life, years	25
General Inflation Rate, %/yr	3.00%
% Financed	66.00%
Loan Interest	8.00%
Loan Term (Years)	12
Tax Rate	34.00%
Prop. Taxes & Ins.	1.50%
Tax Life	20
Depreciation	150% declining balance
Salvage Value	0
Construction Period, years	
Existing Plant Modifications	
LNB	1
LNB/overfire air	1
SNCR (with or without LNB or LNB/OFA)	1
SCR (with or without LNB or LNB/overfire air)	2
FGD	2
Fuel Switch	1
Repowering	
NGCC	2
IGCC	3
PFBC	3
New Units	
PC	3
GCC	2
IGCC	3
PFBC	3
CoCo	3

Table 5A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
10 % Increase in IGCC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Season) = 1500

SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,738	95,737	95,735	95,753	96,049	96,049	96,047	97,866	96,794	97,102	97,945	102,198	98,373	97,623	98,466	107,203	102,473	98,875	98,723
Total New Capacity Required, MW	15,924	15,128	15,128	15,128	15,047	14,730	15,128	15,128	13,063	14,291	14,730	13,934	9,502	12,291	14,730	14,332	4,752	8,317	12,301	12,739
Total Region Capacity Installed, MW	111,662	110,866	110,865	110,863	110,801	110,779	111,177	111,175	110,929	111,086	111,832	111,879	111,699	110,664	112,353	112,797	111,955	110,790	111,176	111,463
Overall Compliance Strategies																				
As-Is, Buy Allowances	25	24	24	23	19	24	23	24	21	23	25	24	20	23	25	24	20	24	24	24
Retrofit Existing Plant	264	266	266	267	269	265	266	265	260	262	260	260	231	254	258	256	150	218	252	254
Fuel Switch	1	0	0	0	2	0	0	0	3	1	0	0	10	3	0	0	16	5	2	1
Retirements	0	0	0	0	0	1	1	1	6	1	2	3	29	5	2	5	104	43	6	6
Replacement With New Gas	0	0	0	0	0	0	0	0	6	1	0	0	29	5	0	0	104	43	6	0
Replacement With New Coal	0	0	0	0	0	1	1	1	0	0	2	3	0	0	2	5	0	0	0	6
Repower	0	0	0	0	0	0	0	0	0	3	3	3	0	5	5	5	0	0	6	5
Additional Capacity-Gas	0	0	0	0	26	0	0	0	24	13	0	0	17	16	0	0	8	14	13	0
Additional Capacity-Coal	40	38	38	38	12	37	38	38	9	23	37	35	7	15	37	36	4	7	18	32
Total Plants	330	328	328	328	328	327	328	328	323	326	327	325	314	321	327	326	302	311	321	322
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6	1	0	0	29	5	0	0	104	43	6	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	1	1	1	0	0	2	3	0	0	2	5	0	0	0	6
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6	1	0	0	29	5	0	0	104	43	6	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	1	1	1	0	0	2	3	0	0	2	5	0	0	0	6
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	1	1	1	6	1	2	3	29	5	2	5	104	43	6	6
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	2	0	0	0	2	1	0	0	7	1	0	0	14	1	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	3	2	0	0	2	4	2	1
FGD	75	76	76	77	74	75	75	76	68	72	71	71	47	64	68	67	4	30	64	65
LNB	73	72	73	74	73	75	78	75	73	75	78	77	64	68	78	76	54	63	69	71
LNB/OFA	152	159	159	159	157	154	153	157	149	148	148	150	125	148	144	147	70	120	146	150
SNCR	26	25	24	23	30	27	25	23	29	28	24	24	25	27	24	23	13	20	24	23
SCR	28	29	29	28	28	28	29	28	27	27	27	27	23	24	25	26	7	18	23	23
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	2	2	2	0	3	4	4	0	0	4	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	26	0	0	0	24	13	0	0	17	16	0	0	8	14	13	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	8	7	7	6	7	7	7	6	7	7	7	6	5	8	7	6	4	4	7	6
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	32	31	31	32	5	30	31	32	2	16	30	29	2	7	30	30	0	3	11	26
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	26	0	0	0	24	13	0	0	17	16	0	0	8	14	13	0
PC	8	7	7	6	7	7	7	6	7	7	7	6	5	8	7	6	4	4	7	6
IGCC	32	31	31	32	5	30	31	32	2	16	30	29	2	7	30	30	0	3	11	26
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	40	38	38	38	38	37	38	38	33	36	37	35	24	31	37	36	12	21	31	32

Table 5B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
10 % Increase in IGGC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Season) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,738	95,737	95,735	95,753	96,049	96,049	96,047	97,866	96,794	97,102	97,945	102,198	98,373	97,623	98,466	107,203	102,473	98,875	98,723
Total New Capacity Required, MW	15,924	15,128	15,128	15,128	15,047	14,730	15,128	15,128	13,063	14,291	14,730	13,934	9,502	12,291	14,730	14,332	4,752	8,317	12,301	12,739
Total Region Capacity Installed, MW	111,662	110,866	110,865	110,863	110,801	110,779	111,177	111,175	110,929	111,086	111,832	111,879	111,699	110,664	112,353	112,797	111,955	110,790	111,176	111,463
Overall Compliance Strategies																				
Existing Non-Fossil	11,879	11,879	11,879	11,879	11,879	12,267	12,267	12,267	11,837	13,044	13,841	14,197	11,779	13,853	14,637	15,790	11,313	11,659	14,222	16,188
As-Is, Buy Allowances	2,606	1,801	1,801	1,913	1,338	1,843	1,693	1,981	1,537	1,663	2,116	1,981	1,451	1,663	2,116	1,981	2,031	2,312	2,277	2,277
Retrofit Existing Plant	81,117	82,058	82,058	81,943	82,309	81,939	82,089	81,799	81,797	81,556	81,145	81,767	76,213	80,621	80,870	80,695	50,418	71,089	79,865	80,188
Fuel Switch	136	0	0	0	227	0	0	0	325	136	0	0	1,299	260	0	0	2,357	427	141	71
Retirements	0	0	0	0	0	398	398	398	2,370	395	796	1,194	11,456	1,975	796	1,991	41,083	16,986	2,370	2,389
Replacement With New Gas	0	0	0	0	0	0	0	0	2,370	395	0	0	11,456	1,975	0	0	41,083	16,986	2,370	0
Replacement With New Coal	0	0	0	0	0	398	398	398	0	0	796	1,194	0	0	796	1,991	0	0	0	2,389
Repower	0	0	0	0	0	0	0	0	0	1,175	1,175	1,175	0	1,984	1,972	1,972	0	0	2,367	1,972
Additional Capacity-Gas	0	0	0	0	10,271	0	0	0	9,481	5,135	0	0	6,715	6,320	0	0	3,160	5,530	5,135	0
Additional Capacity-Coal	15,924	15,128	15,128	15,128	4,777	14,730	15,128	15,128	3,582	9,156	14,730	13,934	2,786	5,971	14,730	14,332	1,592	2,786	7,165	12,739
Total Capacity	99,783	98,987	98,987	98,984	98,922	98,512	98,910	98,908	96,722	98,822	99,167	98,857	88,464	96,820	99,688	98,979	59,559	82,145	96,950	97,246
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	2,370	395	0	0	11,456	1,975	0	0	41,083	16,986	2,370	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	398	398	398	0	0	796	1,194	0	0	796	1,991	0	0	0	2,389
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	2,370	395.027	0	0	11,456	1975.14	0	0	41,083	16,986	2370.16	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	398.128	398.128	398.128	0	0	796.256	1194.38	0	0	796.256	1990.64	0	0	0	2388.77
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	398	398	398	2,370	395	796	1,194	11,456	1,975	796	1,991	41,083	16,986	2,370	2,389
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	227	0	0	0	227	136	0	0	1,031	91	0	0	2,123	91	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	267	169	0	0	235	336	141	71
FGD	26,403	26,496	26,496	26,642	26,326	26,420	26,419	26,565	26,110	25,991	25,899	26,533	21,670	24,997	25,531	25,462	1,526	14,035	24,997	24,571
LNB	8,378	7,578	7,646	8,033	7,110	8,013	8,488	7,796	7,921	7,707	8,647	8,292	6,719	6,888	8,834	8,486	4,938	6,122	6,977	7,168
LNB/OFA	56,843	59,362	59,362	58,860	59,304	58,606	58,483	59,271	58,049	57,953	57,698	58,743	53,201	57,956	56,847	57,477	36,458	50,760	57,725	58,583
SNCR	14,074	13,498	12,923	11,994	16,230	14,120	13,390	12,206	15,855	15,420	12,875	12,727	14,337	15,265	12,875	12,328	8,904	12,136	13,628	13,065
SCR	11,836	10,871	10,871	10,777	11,837	10,632	10,870	10,778	12,225	10,495	10,495	10,640	10,466	10,637	10,762	11,002	3,375	8,559	10,466	10,018
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	796	796	796	0	1,194	1,593	1,593	0	0	1,593	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	10,271	0	0	0	9,481	5,135	0	0	6,715	6,320	0	0	3,160	5,530	5,135	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	3,184	2,786	2,786	2,388	2,786	2,786	2,786	2,388	2,786	2,786	2,786	2,388	1,990	3,184	2,786	2,388	1,592	1,592	2,786	2,388
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	12,740	12,342	12,342	12,740	1,991	11,944	12,342	12,740	796	6,370	11,944	11,546	796	2,787	11,944	11,944	0	1,194	4,379	10,351
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	10,271	0	0	0	9,481	5,135	0	0	6,715	6,320	0	0	3,160	5,530	5,135	0
PC	3184	2786	2786	2388	2786	2786	2786	2388	2786	2786	2786	2388	1990	3184	2786	2388	1592	1592	2786	2388
IGCC	12,740	12,342	12,342	12,740	1,991	11,944	12,342	12,740	796	6,370	11,944	11,546	796	2,787	11,944	11,944	0	1,194	4,379	10,351
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,924	15,128	15,128	15,128	15,047	14,730	15,128	15,128	13,063	14,291	14,730	13,934	9,502	12,291	14,730	14,332	4,752	8,317	12,301	12,739

Table 5C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
10 % Increase in IGCC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Season) = 1500 SOx Allowance Price ($/ton) = 800

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	1	2	3	0
New Capacity-IGCC	32	5	2	2	0	31	30	16	7	3
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	8	7	7	6	7	7	7	6	7	7
Replacement Plants-Gas	0	0	6	29	104	0	0	1	5	43
New Capacity-Gas	0	26	24	17	8	0	0	13	16	14
Total of above	40	38	39	54	119	38	38	39	38	67
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	398	796	1,194	0
New Capacity-IGCC	12,740	1,991	796	796	0	12,342	11,944	6,370	2,787	1,194
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	379	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	2,370	11,456	41,083	0	0	395	1,975	16,986
New Capacity-Gas	0	10270.7	9,481	6,715	3,160	0	0	5,135	6,320	5,530
Total of above	12,740	12,261	12,647	18,967	44,243	12,342	12,342	13,076	12,277	23,711

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	1	4	6	4	0	1	5	9	10
New Capacity-IGCC	31	31	30	30	11	32	32	29	30	26
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	7	7	7	6	7	7	7	6	7	7
Replacement Plants-Gas	0	0	0	0	6	0	0	0	0	0
New Capacity-Gas	0	0	0	0	13	0	0	0	0	0
Total of above	38	39	42	43	42	39	40	41	47	44
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	398	1,593	2,389	1,593	0	398	1,991	3,583	3,981
New Capacity-IGCC	12,342	12,342	11,944	11,944	4,379	12,740	12,740	11,546	11,944	10,351
Replacement Plants-Other Coal (inc CoCo)	0	0	379	379	379	0	0	379	379	379
New Capacity-Other Coal (inc CoCo)	2,786	2,786	2,786	2,786	2,786	2,388	2,388	2,388	2,388	2,388
Replacement Plants-Gas	0	0	0	0	2,370	0	0	0	0	0
New Capacity-Gas	0	0	0	0	5,135	0	0	0	0	0
Total of above	15,128	15,526	16,702	17,498	16,643	15,128	15,526	16,304	18,294	17,100

Table 6A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
20 % Increase in IGGC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500

SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,737	95,728	95,734	95,752	95,750	95,739	96,045	97,866	95,977	95,965	96,271	102,484	98,104	97,563	97,606	107,144	103,113	98,262	97,601
Total New Capacity Required, MW	15,831	15,126	15,127	15,524	15,038	15,880	15,525	15,127	12,668	15,454	15,525	15,525	8,705	12,279	14,255	14,702	4,752	6,704	12,635	13,894
Total Region Capacity Installed, MW	111,569	110,864	110,855	111,258	110,789	111,630	111,265	111,172	110,534	111,431	111,491	111,796	111,189	110,383	111,818	112,308	111,896	109,817	110,897	111,495
Overall Compliance Strategies																				
As-Is, Buy Allowances	19	25	23	25	19	22	23	24	21	22	23	25	20	22	23	24	20	23	24	25
Retrofit Existing Plant	270	265	267	265	270	268	267	266	260	265	266	263	231	257	262	261	150	216	253	258
Fuel Switch	1	0	0	0	1	0	0	0	3	2	0	0	9	2	0	0	16	5	3	0
Retirements	0	0	0	0	0	0	0	0	6	0	0	1	30	8	2	2	104	46	8	2
Replacement With New Gas	0	0	0	0	0	0	0	0	6	0	0	0	30	8	2	1	104	46	8	1
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
Repower	0	0	0	0	0	0	0	0	0	1	1	1	0	1	3	3	0	0	2	5
Additional Capacity-Gas	30	0	0	0	29	14	0	0	23	23	0	0	17	20	16	0	8	12	16	4
Additional Capacity-Coal	10	38	38	39	9	26	39	38	9	16	39	39	5	11	20	37	4	5	16	31
Total Plants	330	328	328	329	328	330	329	328	322	329	329	329	312	321	326	327	302	307	322	325
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6	0	0	0	30	8	2	1	104	46	8	1
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6	0	0	0	30	8	2	1	104	46	8	1
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	0	0	0	6	0	0	1	30	8	2	2	104	46	8	2
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	1	0	0	0	2	2	0	0	6	1	0	0	13	1	1	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	3	1	0	0	3	4	2	0
FGD	75	76	79	76	74	76	79	76	68	74	78	74	46	65	71	70	4	30	65	68
LNB	62	72	74	73	73	72	78	77	73	76	80	81	61	69	76	79	52	64	70	74
LNB/OFA	168	158	159	158	157	161	154	155	149	150	151	148	130	149	150	148	73	120	146	151
SNCR	32	25	24	21	30	29	24	22	29	29	25	23	25	28	25	23	13	20	24	23
SCR	29	29	30	29	29	28	30	29	28	29	29	29	22	25	28	29	7	18	24	26
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	30	0	0	0	29	14	0	0	23	23	0	0	17	20	16	0	8	12	16	4
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	10	19	18	21	9	13	15	15	9	11	13	14	5	11	11	13	4	4	10	11
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	19	20	18	0	13	24	23	0	5	26	25	0	0	8	23	0	0	4	19
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	2	1
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	30	0	0	0	29	14	0	0	23	23	0	0	17	20	16	0	8	12	16	4
PC	10	19	18	21	9	13	15	15	9	11	13	14	5	11	11	13	4	4	10	11
IGCC	0	19	20	18	0	13	24	23	0	5	26	25	0	0	8	23	0	0	4	19
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	2	1
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	40	38	38	39	38	40	39	38	32	39	39	39	22	31	36	37	12	17	32	35

Table 6B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
20 % Increase in IGGC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500

SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,737	95,728	95,734	95,752	95,750	95,739	96,045	97,866	95,977	95,965	96,271	102,484	98,104	97,563	97,606	107,144	103,113	98,262	97,601
Total New Capacity Required, MW	15,831	15,126	15,127	15,524	15,038	15,880	15,525	15,127	12,668	15,454	15,525	15,525	8,705	12,279	14,255	14,702	4,752	6,704	12,635	13,894
Total Region Capacity Installed, MW	111,569	110,864	110,855	111,258	110,789	111,630	111,265	111,172	110,534	111,431	111,491	111,796	111,189	110,383	111,818	112,308	111,896	109,817	110,897	111,495
Overall Compliance Strategies																				
Existing Non-Fossil	11,879	11,879	11,879	11,879	11,879	11,879	11,879	11,869	11,837	12,258	12,258	12,646	11,741	12,264	13,016	13,404	11,352	11,659	12,640	14,200
As-Is, Buy Allowances	1,360	1,874	1,913	2,156	1,338	1,854	1,663	1,798	1,537	1,600	1,663	1,970	1,451	1,600	1,663	1,798	2,031	2,214	2,277	2,412
Retrofit Existing Plant	82,363	81,985	81,936	81,699	82,399	82,017	82,198	82,379	81,797	81,892	82,045	81,654	76,521	80,891	82,094	82,005	50,418	70,642	79,954	80,594
Fuel Switch	136	0	0	0	136	0	0	0	325	227	0	0	920	189	0	0	2,260	427	231	0
Retirements	0	0	0	0	0	0	0	0	2,370	0	0	398	11,851	3,160	790	796	41,083	18,171	3,160	793
Replacement With New Gas	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3,160	790	398	41,083	18,171	3,160	395
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	0	398	0	0	0	398	0	0	0	398
Repower	0	0	0	0	0	0	0	0	0	379	379	379	0	395	1,175	1,175	0	0	774	1,972
Additional Capacity-Gas	11,851	0	0	0	11,456	5,530	0	0	9,086	9,086	0	0	6,715	7,901	6,320	0	3,160	4,740	6,320	1,580
Additional Capacity-Coal	3,980	15,126	15,127	15,524	3,582	10,350	15,525	15,127	3,582	6,369	15,525	15,525	1,990	4,378	7,934	14,702	1,592	1,963	6,315	12,314
Total Capacity	99,690	98,985	98,976	99,379	98,911	99,751	99,386	99,303	96,326	99,552	99,612	99,529	87,597	95,353	99,187	99,681	59,461	79,987	95,871	98,871
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3,160	790	398	41,083	18,171	3,160	395
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	398	0	0	0	398	0	0	0	398
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3160.22	790.054	398.128	41,083	18,171	3160.22	395.027
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	0	398.128	0	0	0	398.128	0	0	0	398.128
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	0	0	0	2,370	0	0	398	11,851	3,160	790	796	41,083	18,171	3,160	793
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	136	0	0	0	227	227	0	0	653	91	0	0	1,956	91	91	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	267	98	0	0	304	336	141	0
FGD	26,403	26,496	27,048	26,715	26,326	26,508	27,060	27,037	26,110	26,266	26,906	26,485	21,602	25,134	26,660	26,571	1,526	14,035	25,309	25,775
LNB	6,116	7,890	7,808	7,648	7,110	7,045	8,517	8,067	7,612	7,575	8,657	8,663	5,820	6,710	8,617	9,015	4,554	5,617	7,071	7,441
LNB/OFA	60,266	58,976	59,084	59,007	59,303	59,970	58,568	59,267	58,357	58,420	58,274	57,947	54,501	58,266	58,044	57,946	36,951	51,173	57,725	58,722
SNCR	17,169	13,498	12,762	10,562	16,230	15,855	12,752	12,073	15,855	15,855	13,007	12,328	14,337	15,420	14,175	12,328	8,904	12,136	13,628	13,053
SCR	12,474	10,871	11,183	11,090	12,474	10,632	11,183	11,090	12,863	11,930	10,944	11,090	9,952	11,935	11,872	12,111	3,375	8,560	10,778	12,143
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	796	796	0	0	0	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	11,851	0	0	0	11,456	5,530	0	0	9,086	9,086	0	0	6,715	7,901	6,320	0	3,160	4,740	6,320	1,580
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	3,980	7,562	7,164	8,358	3,582	5,174	5,970	5,970	3,582	4,378	5,174	5,572	1,990	4,378	4,378	5,174	1,592	1,592	3,980	4,378
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	7,564	7,963	7,166	0	5,176	9,555	9,157	0	1,991	10,351	9,953	0	0	3,185	9,157	0	0	1,593	7,564
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	371	371	0	371	742	371
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	11,851	0	0	0	11,456	5,530	0	0	9,086	9,086	0	0	6,715	7,901	6,320	0	3,160	4,740	6,320	1,580
PC	3980	7562	7164	8358	3582	5174	5970	5970	3582	4378	5174	5572	1990	4378	4378	5174	1592	1592	3980	4378
IGCC	0	7,564	7,963	7,166	0	5,176	9,555	9,157	0	1,991	10,351	9,953	0	0	3,185	9,157	0	0	1,593	7,564
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	371.184	371	0	371.184	742.368	371
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,831	15,126	15,127	15,524	15,038	15,880	15,525	15,127	12,668	15,454	15,525	15,525	8,705	12,279	14,255	14,702	4,752	6,704	12,635	13,894

Table 6C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
20 % Increase in IGGC Capital Cost

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	0	0	0	0	0	19	13	5	0	0
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	10	19	18	21	9	13	15	15	9	12
Replacement Plants-Gas	0	0	6	30	104	0	0	0	8	46
New Capacity-Gas	30	29	23	17	8	0	14	23	20	12
Total of above	40	48	47	68	121	32	42	44	37	70
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	0	0	0	0	0	7,564	5,176	1,991	0	0
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	371.184
Replacement Plants-Gas	0	0	2,370	11,851	41,083	0	0	0	3,160	18,171
New Capacity-Gas	11850.81	11455.78	9,086	6,715	3,160	0	5530.378	9085.621	7,901	4,740
Total of above	11,851	11,456	11,456	18,566	44,243	7,564	10,706	11,077	11,061	23,283

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	2	0	0	0	1	3	5
New Capacity-IGCC	20	24	26	8	4	18	23	25	23	19
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	18	19	18	22	11	13	15	15	10	12
Replacement Plants-Gas	0	0	0	2	8	0	0	0	1	1
New Capacity-Gas	0	0	0	16	16	0	0	0	0	4
Total of above	38	43	45	51	40	31	38	42	38	42
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	796	0	0	0	398	1,194	1,991
New Capacity-IGCC	7,963	9,555	10,351	3,185	1,593	7,166	9,157	9,953	9,157	7,564
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	7,164	5,970	5,174	4,749	4,722	8,358	5,970	5,572	5,545	4,749
Replacement Plants-Gas	0	0	0	790	3,160	0	0	0	398	395
New Capacity-Gas	0	0	0	6,320	6,320	0	0	0	0	1,580
Total of above	15,127	15,525	15,526	15,842	15,797	15,524	15,127	15,924	16,296	16,280

Table 7A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
10 % Increase in IGCC Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,038	96,038	96,037	96,036	95,752	96,049	96,049	96,340	97,601	96,842	97,104	97,658	102,200	98,959	98,176	98,178	103,822	103,069	99,354	98,425
Total New Capacity Required, MW	15,129	15,129	15,129	15,129	15,092	14,731	15,129	14,731	12,280	14,317	14,731	13,934	9,509	12,292	13,138	14,333	4,753	6,731	11,104	13,138
Total Region Capacity Installed, MW	111,166	111,166	111,166	111,165	110,844	110,780	111,178	111,071	109,881	111,159	111,834	111,592	111,709	111,251	111,314	112,511	108,575	109,800	110,458	111,563
Overall Compliance Strategies																				
As-Is, Buy Allowances	25	24	25	24	23	23	23	22	23	23	25	25	20	23	23	24	19	22	24	25
Retrofit Existing Plant	263	264	264	265	266	266	266	266	258	262	260	258	229	252	258	257	153	219	252	255
Fuel Switch	1	0	0	0	1	0	0	0	3	1	0	0	12	3	0	0	16	4	1	0
Retirements	1	1	1	1	0	1	1	2	6	2	3	4	29	10	4	4	102	45	9	5
Replacement With New Gas	0	0	0	0	0	0	0	0	6	0	0	0	29	10	1	0	102	45	8	0
Replacement With New Coal	1	1	1	1	0	1	1	2	0	2	3	4	0	0	3	4	0	0	1	5
Repower	0	0	0	0	0	0	0	0	0	2	2	3	0	2	5	5	0	0	4	5
Additional Capacity-Gas	0	0	0	0	12	0	0	0	20	5	0	0	15	16	0	0	8	12	14	0
Additional Capacity-Coal	38	38	38	38	26	37	38	37	11	31	37	35	9	15	33	36	4	5	14	33
Total Plants	328	327	328	328	328	327	328	327	321	326	327	325	314	321	323	326	302	307	318	323
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6	0	0	0	29	10	1	0	102	45	8	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	1	1	1	1	0	1	1	2	0	2	3	4	0	0	3	4	0	0	1	5
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6	0	0	0	29	10	1	0	102	45	8	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	1	1	1	1	0	1	1	2	0	2	3	4	0	0	3	4	0	0	1	5
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	1	1	1	1	0	1	1	2	6	2	3	4	29	10	4	4	102	45	9	5
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	1	0	0	0	2	1	0	0	9	0	0	0	11	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	3	3	0	0	5	4	1	0
FGD	74	75	75	75	74	75	75	74	68	72	72	69	47	64	67	67	7	30	64	66
LNB	73	72	75	74	76	76	78	77	71	76	78	75	62	67	74	76	48	63	68	73
LNB/OFA	151	157	155	157	150	154	153	155	148	147	147	150	125	147	148	148	75	121	148	149
SNCR	26	25	24	23	28	27	25	24	28	27	24	23	25	27	25	23	11	20	24	23
SCR	28	29	29	28	28	28	29	28	27	28	28	27	22	24	25	26	9	18	23	23
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	1	1	2	0	0	4	4	0	0	2	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	12	0	0	0	20	5	0	0	15	16	0	0	8	12	14	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	38	38	38	38	26	37	38	37	11	31	37	35	9	15	33	36	4	5	14	33
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	12	0	0	0	20	5	0	0	15	16	0	0	8	12	14	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	38	38	38	38	26	37	38	37	11	31	37	35	9	15	33	36	4	5	14	33
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	38	38	38	38	38	37	38	37	31	36	37	35	24	31	33	36	12	17	28	33

Table 7B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
10 % Increase in IGCC Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Fully Developed				Fully Developed				Fully Developed				Fully Developed				Fully Developed			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,038	96,038	96,037	96,036	95,752	96,049	96,049	96,340	97,601	96,842	97,104	97,658	102,200	98,959	98,176	98,178	103,822	103,069	99,354	98,425
Total New Capacity Required, MW	15,129	15,129	15,129	15,129	15,092	14,731	15,129	14,731	12,280	14,317	14,731	13,934	9,509	12,292	13,138	14,333	4,753	6,731	11,104	13,138
Total Region Capacity Installed, MW	111,166	111,166	111,166	111,165	110,844	110,780	111,178	111,071	109,881	111,159	111,834	111,592	111,709	111,251	111,314	112,511	108,575	109,800	110,458	111,563
Overall Compliance Strategies																				
Existing Non-Fossil	12,267	12,405	12,267	12,267	11,879	12,267	12,267	12,627	11,840	13,443	13,841	14,599	11,779	12,648	14,997	15,395	11,391	11,649	13,819	15,793
As-Is, Buy Allowances	2,606	1,801	2,156	2,021	1,661	1,693	1,693	1,558	1,663	1,663	2,066	2,035	1,451	1,663	1,663	1,981	1,924	2,128	2,277	2,595
Retrofit Existing Plant	81,028	81,832	81,614	81,748	82,076	82,089	82,089	82,155	81,404	81,600	81,197	81,024	75,965	80,430	81,122	80,803	47,874	71,180	80,026	80,037
Fuel Switch	136	0	0	0	136	0	0	0	325	136	0	0	1,549	267	0	0	2,341	336	72	0
Retirements	398	398	398	398	0	398	398	796	2,370	796	1,194	1,593	11,456	3,950	1,589	1,593	40,293	17,776	3,558	1,991
Replacement With New Gas	0	0	0	0	0	0	0	0	2,370	0	0	0	11,456	3,950	395	0	40,293	17,776	3,160	0
Replacement With New Coal	398	398	398	398	0	398	398	796	0	796	1,194	1,593	0	0	1,194	1,593	0	0	398	1,991
Repower	0	0	0	0	0	0	0	0	0	777	777	1,175	0	790	1,972	1,972	0	0	1,570	1,972
Additional Capacity-Gas	0	0	0	0	4,740	0	0	0	7,901	1,975	0	0	5,925	6,320	0	0	3,160	4,740	5,530	0
Additional Capacity-Coal	15,129	15,129	15,129	15,129	10,351	14,731	15,129	14,731	4,379	12,342	14,731	13,934	3,583	5,972	13,138	14,333	1,593	1,991	5,574	13,138
Total Capacity	98,899	98,762	98,898	98,898	98,965	98,513	98,910	98,444	95,671	98,494	98,771	98,169	88,474	95,443	97,894	99,088	56,891	80,375	95,049	97,742
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,456	3,950	395	0	40,293	17,776	3,160	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	398	398	398	398	0	398	398	796	0	796	1,194	1,593	0	0	1,194	1,593	0	0	398	1,991
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,456	3950.27	395.027	0	40,293	17,776	3160.22	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	398	398.128	398.128	398.128	0	398.128	398.128	796.256	0	796.256	1194.38	1592.51	0	0	1194.38	1592.51	0	0	398.128	1990.64
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	398	398	398	398	0	398	398	796	2,370	796	1,194	1,593	11,456	3,950	1,589	1,593	40,293	17,776	3,558	1,991
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	136	0	0	0	227	136	0	0	1,282	0	0	0	1,867	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	267	267	0	0	473	336	72	0
FGD	26,315	26,408	26,407	26,447	26,326	26,420	26,419	26,391	25,842	26,036	26,036	25,737	21,670	24,997	25,463	25,462	2,102	14,035	25,223	25,309
LNB	8,378	7,602	8,193	8,033	8,138	8,163	8,488	8,326	7,218	8,137	8,450	8,111	6,471	6,855	7,574	8,125	3,084	5,579	6,666	7,098
LNB/OFA	56,755	59,111	58,370	58,665	57,952	58,606	58,483	58,779	58,195	57,567	57,745	58,182	53,201	57,798	58,109	57,946	35,114	51,394	58,333	58,618
SNCR	14,074	13,498	12,923	11,994	15,420	14,120	13,390	12,461	15,420	15,265	12,875	12,328	14,337	15,265	14,175	12,328	6,664	12,136	13,628	13,053
SCR	11,836	10,871	10,870	10,777	11,837	10,632	10,870	10,777	11,957	10,632	10,632	10,640	10,166	10,637	10,764	11,002	4,501	8,560	10,466	10,019
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	398	398	796	0	0	1,593	1,593	0	0	796	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	4,740	0	0	0	7,901	1,975	0	0	5,925	6,320	0	0	3,160	4,740	5,530	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	15,129	15,129	15,129	15,129	10,351	14,731	15,129	14,731	4,379	12,342	14,731	13,934	3,583	5,972	13,138	14,333	1,593	1,991	5,574	13,138
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	4,740	0	0	0	7,901	1,975	0	0	5,925	6,320	0	0	3,160	4,740	5,530	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	15,129	15,129	15,129	15,129	10,351	14,731	15,129	14,731	4,379	12,342	14,731	13,934	3,583	5,972	13,138	14,333	1,593	1,991	5,574	13,138
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,129	15,129	15,129	15,129	15,092	14,731	15,129	14,731	12,280	14,317	14,731	13,934	9,509	12,292	13,138	14,333	4,753	6,731	11,104	13,138

Table 7C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
10 % Increase in IGCC Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	1	0	0	0	0	1	1	3	0	0
New Capacity-IGCC	38	26	11	9	4	38	37	31	15	5
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	6	29	102	0	0	0	10	45
New Capacity-Gas	0	12	20	15	8	0	0	5	16	12
Total of above	39	38	37	53	114	39	38	40	41	62
Installed Capacity, MW gross										
Replacement Plants-IGCC	398	0	0	0	0	398	398	1,194	0	0
New Capacity-IGCC	15,129	10,351	4,379	3,583	1,593	15,129	14,731	12,342	5,972	1,991
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	2,370	11,456	40,293	0	0	0	3,950	17,776
New Capacity-Gas	0	4740.324	7,901	5,925	3,160	0	0	1975.135	6,320	4,740
Total of above	15,527	15,092	14,650	20,964	45,045	15,527	15,129	15,512	16,243	24,507

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	1	1	4	7	3	1	2	6	8	9
New Capacity-IGCC	38	38	37	33	14	38	37	35	36	33
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	1	8	0	0	0	0	0
New Capacity-Gas	0	0	0	0	14	0	0	0	0	0
Total of above	39	39	42	42	40	39	39	42	45	43
Installed Capacity, MW gross										
Replacement Plants-IGCC	398	398	1,593	2,787	1,194	398	796	2,389	3,185	3,583
New Capacity-IGCC	15,129	15,129	14,731	13,138	5,574	15,129	14,731	13,934	14,333	13,138
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	395	3,160	0	0	0	0	0
New Capacity-Gas	0	0	0	0	5,530	0	0	0	0	0
Total of above	15,527	15,527	16,324	16,321	15,460	15,527	15,527	16,324	17,519	16,722

Table 8A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
20 % Increase in IGGC Heat Rate

NOx Allowance Price ($/ton, Year-round) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,037	95,736	95,737	96,039	95,751	96,047	96,049	96,051	97,599	95,974	96,275	96,568	102,457	98,650	96,561	96,873	107,189	102,638	98,303	97,651
Total New Capacity Required, MW	15,129	15,129	15,527	15,129	14,663	14,731	15,129	15,129	12,271	14,280	15,925	15,527	9,502	11,888	15,085	15,527	4,358	7,919	13,089	13,910
Total Region Capacity Installed, MW	111,165	110,865	111,264	111,168	110,414	110,778	111,178	111,180	109,870	110,254	112,200	112,095	111,959	110,538	111,647	112,400	111,547	110,557	111,391	111,560
Overall Compliance Strategies																				
As-Is, Buy Allowances	24	24	25	25	21	23	24	23	20	23	26	26	20	24	26	25	20	24	24	25
Retrofit Existing Plant	266	266	265	265	268	266	265	266	262	265	262	261	230	252	261	261	151	217	254	259
Fuel Switch	0	0	0	0	1	0	0	0	2	1	0	0	10	3	0	0	15	5	2	0
Retirements	0	0	0	0	0	1	1	1	6	0	1	2	30	9	2	3	104	44	8	3
Replacement With New Gas	0	0	0	0	0	0	0	0	6	0	0	0	30	9	2	0	104	44	8	1
Replacement With New Coal	0	0	0	0	0	1	1	1	0	0	1	2	0	0	0	3	0	0	0	2
Repower	0	0	0	0	0	0	0	0	0	1	1	1	0	2	1	1	0	0	2	3
Additional Capacity-Gas	0	0	0	0	22	0	0	0	23	17	0	0	17	18	14	0	7	14	16	8
Additional Capacity-Coal	38	38	39	38	15	37	38	38	8	19	40	39	7	12	24	39	4	6	17	27
Total Plants	328	328	329	328	327	327	328	328	321	326	330	329	314	320	328	329	301	310	323	325
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	6	0	0	0	30	9	2	0	104	44	8	1
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	1	1	1	0	0	1	2	0	0	0	3	0	0	0	2
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	6	0	0	0	30	9	2	0	104	44	8	1
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	1	1	1	0	0	1	2	0	0	0	3	0	0	0	2
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	1	1	1	6	0	1	2	30	9	2	3	104	44	8	3
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	0	0	0	0	1	0	0	0	1	1	0	0	7	1	0	0	13	1	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	3	2	0	0	2	4	2	0
FGD	76	77	76	74	75	76	75	74	69	75	74	72	47	64	71	71	5	30	65	69
LNB	73	71	74	74	74	76	77	78	74	76	80	79	64	65	77	80	53	62	71	75
LNB/OFA	154	160	157	157	155	154	153	154	149	150	148	149	124	151	149	148	71	121	145	151
SNCR	28	26	24	21	30	28	25	22	29	29	24	23	25	30	25	23	13	20	24	24
SCR	27	29	29	28	27	28	29	28	26	29	28	28	22	24	29	29	7	18	24	27
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	22	0	0	0	23	17	0	0	17	18	14	0	7	14	16	8
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	38	38	39	38	15	37	38	38	8	19	40	39	7	12	24	39	4	6	17	27
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	22	0	0	0	23	17	0	0	17	18	14	0	7	14	16	8
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	38	38	39	38	15	37	38	38	8	19	40	39	7	12	24	39	4	6	17	27
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	38	38	39	38	37	37	38	38	31	36	40	39	24	30	38	39	11	20	33	35

Table 8B. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
20 % Increase in IGGC Heat Rate

NOx Allowance Price ($/ton, Year-round) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,037	95,736	95,737	96,039	95,751	96,047	96,049	96,051	97,599	95,974	96,275	96,568	102,457	98,650	96,561	96,873	107,189	102,638	98,303	97,651
Total New Capacity Required, MW	15,129	15,129	15,527	15,129	14,663	14,731	15,129	15,129	12,271	14,280	15,925	15,527	9,502	11,888	15,085	15,527	4,358	7,919	13,089	13,910
Total Region Capacity Installed, MW	111,165	110,865	111,264	111,168	110,414	110,778	111,178	111,180	109,870	110,254	112,200	112,095	111,959	110,538	111,647	112,400	111,547	110,557	111,391	111,560
Overall Compliance Strategies																				
Existing Non-Fossil	11,869	11,879	11,879	11,869	11,879	12,267	12,267	12,267	11,840	12,258	12,646	13,006	11,779	12,620	12,210	13,404	11,324	11,659	12,630	13,802
As-Is, Buy Allowances	1,787	1,746	2,156	2,156	1,464	1,721	1,796	1,693	1,432	1,663	2,278	2,279	1,451	1,691	2,189	2,116	2,031	2,346	2,277	2,412
Retrofit Existing Plant	82,381	82,111	81,702	82,014	82,318	82,059	81,986	82,091	81,769	81,962	81,350	81,284	76,114	80,523	81,373	81,353	50,530	70,825	80,095	81,041
Fuel Switch	0	0	0	0	91	0	0	0	189	91	0	0	1,261	260	0	0	2,221	427	141	0
Retirements	0	0	0	0	0	398	398	398	2,370	0	398	796	11,851	3,555	790	1,194	41,083	17,381	3,160	1,191
Replacement With New Gas	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3,555	790	0	41,083	17,381	3,160	395
Replacement With New Coal	0	0	0	0	0	398	398	398	0	0	398	796	0	0	0	1,194	0	0	0	796
Repower	0	0	0	0	0	0	0	0	0	379	379	379	0	790	379	379	0	0	774	1,175
Additional Capacity-Gas	0	0	0	0	8,691	0	0	0	9,086	6,715	0	0	6,715	7,110	5,530	0	2,765	5,530	6,320	3,160
Additional Capacity-Coal	15,129	15,129	15,527	15,129	5,972	14,731	15,129	15,129	3,185	7,564	15,925	15,527	2,787	4,778	9,555	15,527	1,593	2,389	6,768	10,749
Total Capacity	99,297	98,986	99,385	99,299	98,535	98,510	98,910	98,913	95,660	98,375	99,933	99,469	88,329	95,153	99,026	99,375	59,140	81,517	96,376	98,538
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3,555	790	0	41,083	17,381	3,160	395
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	398	398	398	0	0	398	796	0	0	0	1,194	0	0	0	796
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	2,370	0	0	0	11,851	3555.24	790.054	0	41,083	17,381	3160.22	395.027
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	398.128	398.128	398.128	0	0	398.128	796.256	0	0	0	1194.38	0	0	0	796.256
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	398	398	398	2,370	0	398	796	11,851	3,555	790	1,194	41,083	17,381	3,160	1,191
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	0	0	0	0	91	0	0	0	91	91	0	0	994	91	0	0	1,986	91	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	267	169	0	0	235	336	141	0
FGD	26,845	26,629	26,496	26,586	26,459	26,553	26,419	26,326	25,974	26,399	26,266	26,105	21,670	25,062	26,013	26,012	1,640	14,035	25,134	25,998
LNB	8,006	7,498	8,031	8,035	7,506	8,163	8,385	8,087	7,757	8,142	8,603	8,219	7,254	6,163	7,982	8,675	4,688	5,927	7,453	8,101
LNB/OFA	58,479	59,494	58,621	58,929	58,916	58,576	58,483	58,954	58,051	57,924	57,947	58,332	52,567	58,786	58,270	57,946	36,707	50,853	57,342	58,504
SNCR	14,562	13,631	12,923	11,568	15,988	14,253	13,390	11,973	15,855	15,553	12,875	12,328	14,337	15,988	14,175	12,328	8,904	12,136	13,628	13,628
SCR	10,538	10,871	10,870	11,949	10,538	10,632	10,870	10,778	10,659	11,269	10,632	10,778	10,165	10,637	12,474	11,414	3,375	8,560	11,764	12,367
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	796
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	8,691	0	0	0	9,086	6,715	0	0	6,715	7,110	5,530	0	2,765	5,530	6,320	3,160
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	15,129	15,129	15,527	15,129	5,972	14,731	15,129	15,129	3,185	7,564	15,925	15,527	2,787	4,778	9,555	15,527	1,593	2,389	6,768	10,749
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	8,691	0	0	0	9,086	6,715	0	0	6,715	7,110	5,530	0	2,765	5,530	6,320	3,160
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	15,129	15,129	15,527	15,129	5,972	14,731	15,129	15,129	3,185	7,564	15,925	15,527	2,787	4,778	9,555	15,527	1,593	2,389	6,768	10,749
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,129	15,129	15,527	15,129	14,663	14,731	15,129	15,129	12,271	14,280	15,925	15,527	9,502	11,888	15,085	15,527	4,358	7,919	13,089	13,910

Table 8C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
20 % Increase in IGGC Heat Rate

NOx Allowance Price ($/ton, Year-round) = 1500   SOx Allowance Price ($/ton) = 800

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	1	0	0	0
New Capacity-IGCC	38	15	8	7	4	38	37	19	12	6
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	6	30	104	0	0	0	9	44
New Capacity-Gas	0	22	23	17	7	0	0	17	18	14
Total of above	38	37	37	54	115	38	38	37	39	64
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	398	0	0	0
New Capacity-IGCC	15,129	5,972	3,185	2,787	1,593	15,129	14,731	7,564	4,778	2,389
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	2,370	11,851	41,083	0	0	0	3,555	17,381
New Capacity-Gas	0	8690.594	9,086	6,715	2,765	0	0	6715.459	7,110	5,530
Total of above	15,129	14,663	14,641	21,353	45,441	15,129	15,129	14,281	15,443	25,300

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	1	1	0	0	0	1	2	3	4
New Capacity-IGCC	39	38	40	24	17	38	38	39	39	27
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	2	8	0	0	0	0	1
New Capacity-Gas	0	0	0	14	16	0	0	0	0	8
Total of above	39	39	42	41	42	38	39	42	43	41
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	398	398	0	0	0	398	796	1,194	1,593
New Capacity-IGCC	15,527	15,129	15,925	9,555	6,768	15,129	15,129	15,527	15,527	10,749
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	0	790	3,160	0	0	0	0	395
New Capacity-Gas	0	0	0	5,530	6,320	0	0	0	0	3,160
Total of above	15,527	15,527	16,324	15,877	16,250	15,129	15,527	16,324	16,722	15,898

Table 9A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
5 % Increase in IGCC Capital Cost & Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,036	95,738	96,028	96,031	95,753	96,049	96,039	96,041	98,124	96,536	97,645	97,939	102,197	98,661	98,455	98,460	107,245	102,768	99,418	98,706
Total New Capacity Required, MW	15,128	15,527	15,527	15,129	15,070	14,730	15,129	14,730	12,671	14,712	14,332	13,536	9,505	12,690	13,934	13,138	4,753	6,731	11,107	12,740
Total Region Capacity Installed, MW	111,165	111,264	111,555	111,160	110,823	110,779	111,168	110,771	110,795	111,248	111,978	111,476	111,702	111,351	112,389	111,598	111,997	109,499	110,525	111,446
Overall Compliance Strategies																				
As-Is, Buy Allowances	25	25	24	23	22	23	23	22	23	24	23	23	20	23	23	23	21	22	25	25
Retrofit Existing Plant	264	265	265	267	266	266	265	267	257	262	261	260	231	253	255	257	149	221	250	253
Fuel Switch	1	0	0	0	2	0	0	0	3	1	0	0	10	3	2	0	18	3	2	1
Retirements	0	0	0	0	0	1	1	1	7	1	3	4	29	8	5	5	102	44	7	6
Replacement With New Gas	0	0	0	0	0	0	0	0	7	0	0	0	29	8	2	0	102	44	7	0
Replacement With New Coal	0	0	0	0	0	1	1	1	0	1	3	4	0	0	3	5	0	0	0	6
Repower	0	0	0	0	0	0	0	0	0	2	3	3	0	3	5	5	0	0	6	5
Additional Capacity-Gas	0	0	0	0	19	0	0	0	22	6	0	0	16	16	0	0	8	12	13	0
Additional Capacity-Coal	38	39	39	38	19	37	38	37	10	31	36	34	8	16	35	33	4	5	15	32
Total Plants	328	329	328	328	328	327	327	327	322	327	326	324	314	322	325	323	302	307	318	322
Reference Figure																				
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	7	0	0	0	29	8	2	0	102	44	7	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	1	1	1	0	1	3	4	0	0	3	5	0	0	0	6
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	7	0	0	0	29	8	2	0	102	44	7	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	1	1	1	0	1	3	4	0	0	3	5	0	0	0	6
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	1	1	1	7	1	3	4	29	8	5	5	102	44	7	6
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	2	0	0	0	2	1	0	0	7	0	0	0	14	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	3	3	2	0	4	3	2	1
FGD	75	76	79	77	74	75	78	77	67	73	73	71	47	64	68	68	4	30	66	67
LNB	74	73	73	74	73	76	76	77	72	77	78	77	65	68	73	75	54	62	66	70
LNB/OFA	151	157	158	159	154	154	154	156	147	147	148	149	124	147	146	148	71	124	148	150
SNCR	26	25	23	21	28	27	25	23	28	28	24	23	25	27	24	23	14	20	25	23
SCR	28	29	30	28	28	28	30	29	26	28	28	28	22	24	26	27	7	18	24	24
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	1	2	2	0	1	4	4	0	0	4	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	19	0	0	0	22	6	0	0	16	16	0	0	8	12	13	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	3	3	2	2	3	3	2	2	3	3	2	2	1	3	2	2	0	0	1	2
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	35	36	37	36	16	34	36	35	7	28	34	32	7	13	33	31	4	5	14	30
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	19	0	0	0	22	6	0	0	16	16	0	0	8	12	13	0
PC	3	3	2	2	3	3	2	2	3	3	2	2	1	3	2	2	0	0	1	2
IGCC	35	36	37	36	16	34	36	35	7	28	34	32	7	13	33	31	4	5	14	30
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	38	39	39	38	38	37	38	37	32	37	36	34	24	32	35	33	12	17	28	32

Table 9B.YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
5 % Increase in IGCC Capital Cost & Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Fully Developed Partially Advanced IGCC				Partially Advanced IGCC			
Carbon Tax	None				25				50								100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	96,036	95,738	96,028	96,031	95,753	96,049	96,039	96,041	98,124	96,536	97,645	97,939	102,197	98,661	98,455	98,460	107,245	102,768	99,418	98,706
Total New Capacity Required, MW	15,128	15,527	15,527	15,129	15,070	14,730	15,129	14,730	12,671	14,712	14,332	13,536	9,505	12,690	13,934	13,138	4,753	6,731	11,107	12,740
Total Region Capacity Installed, MW	111,165	111,264	111,555	111,160	110,823	110,779	111,168	110,771	110,795	111,248	111,978	111,476	111,702	111,351	112,389	111,598	111,997	109,499	110,525	111,446
Overall Compliance Strategies																				
Existing Non-Fossil	11,869	11,879	11,961	11,869	11,879	12,267	12,470	12,267	11,837	13,044	14,236	14,596	11,779	13,046	14,993	15,790	11,323	11,649	14,219	16,188
As-Is, Buy Allowances	2,606	2,156	2,498	1,913	1,558	1,693	1,663	1,558	1,663	1,981	1,663	1,663	1,451	1,663	1,663	1,663	2,281	2,128	2,305	2,305
Retrofit Existing Plant	81,425	81,703	81,568	82,250	82,089	82,089	81,906	82,216	81,534	81,375	81,747	81,681	76,212	80,524	80,868	81,007	50,720	71,343	79,988	80,142
Fuel Switch	136	0	0	0	227	0	0	0	325	136	0	0	1,299	267	141	0	2,628	267	141	71
Retirements	0	0	0	0	0	398	398	398	2,765	398	1,194	1,593	11,456	3,160	1,984	1,991	40,293	17,381	2,765	2,389
Replacement With New Gas	0	0	0	0	0	0	0	0	2,765	0	0	0	11,456	3,160	790	0	40,293	17,381	2,765	0
Replacement With New Coal	0	0	0	0	0	398	398	398	0	398	1,194	1,593	0	0	1,194	1,991	0	0	0	2,389
Repower	0	0	0	0	0	0	0	0	0	777	1,175	1,175	0	1,188	1,972	1,972	0	0	2,367	1,972
Additional Capacity-Gas	0	0	0	0	7,506	0	0	0	8,691	2,370	0	0	6,320	6,320	0	0	3,160	4,740	5,135	0
Additional Capacity-Coal	15,128	15,527	15,527	15,129	7,564	14,730	15,129	14,730	3,981	12,342	14,332	13,536	3,185	6,370	13,934	13,138	1,593	1,991	5,972	12,740
Total Capacity	99,296	99,386	99,593	99,291	98,944	98,512	98,697	98,504	96,193	98,981	98,917	98,055	88,467	96,333	98,578	97,780	60,382	80,469	95,907	97,229
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	2,765	0	0	0	11,456	3,160	790	0	40,293	17,381	2,765	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	398	398	398	0	398	1,194	1,593	0	0	1,194	1,991	0	0	0	2,389
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	2,765	0	0	0	11,456	3160.22	790.054	0	40,293	17,381	2765.19	0
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	398	398	398	0	398	1,194	1,593	0	0	1194.38	1990.64	0	0	0	2388.77
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	398	398	398	2,765	398	1,194	1,593	11,456	3,160	1,984	1,991	40,293	17,381	2,765	2,389
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	227	0	0	0	227	136	0	0	1,031	0	0	0	2,123	0	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	267	267	141	0	506	267	141	71
FGD	26,713	26,496	27,357	27,137	26,326	26,420	26,971	26,878	25,973	26,128	26,609	26,448	21,670	24,997	25,775	25,775	1,526	14,035	25,707	25,622
LNB	9,261	7,740	7,716	8,035	7,657	8,163	8,237	8,286	7,797	8,230	8,923	8,292	7,352	6,949	7,568	8,017	4,797	5,448	6,208	7,140
LNB/OFA	56,268	58,845	58,808	59,170	58,537	58,606	58,556	58,885	57,909	57,567	57,711	58,345	52,567	57,798	57,866	57,946	37,125	51,688	58,757	58,571
SNCR	14,074	13,498	11,462	10,400	15,420	14,120	13,267	12,206	15,420	15,420	12,875	12,328	14,337	15,265	12,875	12,328	9,142	12,136	14,027	13,053
SCR	11,835	10,871	11,183	10,963	11,837	10,632	11,183	11,090	12,088	10,632	10,806	10,952	10,165	10,637	11,076	11,315	3,375	8,560	10,779	10,331
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	398	796	796	0	398	1,593	1,593	0	0	1,593	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	7,506	0	0	0	8,691	2,370	0	0	6,320	6,320	0	0	3,160	4,740	5,135	0
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	1,194	1,194	796	796	1,194	1,194	796	796	1,194	1,194	796	796	398	1,194	796	796	0	0	398	796
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	13,934	14,333	14,731	14,333	6,370	13,536	14,333	13,934	2,787	11,148	13,536	12,740	2,787	5,176	13,138	12,342	1,593	1,991	5,574	11,944
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	0	0	0	0	7,506	0	0	0	8,691	2,370	0	0	6,320	6,320	0	0	3,160	4,740	5,135	0
PC	1194	1194	796	796	1194	1194	796	796	1194	1194	796	796	398	1194	796	796	0	0	398	796
IGCC	13,934	14,333	14,731	14,333	6,370	13,536	14,333	13,934	2,787	11,148	13,536	12,740	2,787	5,176	13,138	12,342	1,593	1,991	5,574	11,944
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,128	15,527	15,527	15,129	15,070	14,730	15,129	14,730	12,671	14,712	14,332	13,536	9,505	12,690	13,934	13,138	4,753	6,731	11,107	12,740

Table 9C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
5 % Increase in IGGC Capital Cost & Heat Rate

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	1	2	1	0
New Capacity-IGCC	35	16	7	7	4	36	34	28	13	5
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	3	3	2	2	3	3	2	2	3	3
Replacement Plants-Gas	0	0	7	29	102	0	0	0	8	44
New Capacity-Gas	0	19	22	16	8	0	0	6	16	12
Total of above	38	38	38	54	117	39	37	39	41	64
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	398	796	398	0
New Capacity-IGCC	13,934	6,370	2,787	2,787	1,593	14,333	13,536	11,148	5,176	1,991
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	2,765	11,456	40,293	0	0	0	3,160	17,381
New Capacity-Gas	0	7505.513	8,691	6,320	3,160	0	0	2370.162	6,320	4,740
Total of above	13,934	13,876	14,243	20,563	45,045	14,333	13,934	14,315	15,054	24,112

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	1	5	7	4	0	1	6	9	10
New Capacity-IGCC	37	36	34	33	14	36	35	32	31	30
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	2	3	2	2	3	3	2	2	3	3
Replacement Plants-Gas	0	0	0	2	7	0	0	0	0	0
New Capacity-Gas	0	0	0	0	13	0	0	0	0	0
Total of above	39	40	42	45	42	39	38	41	44	44
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	398	1,991	2,787	1,593	0	398	2,389	3,583	3,981
New Capacity-IGCC	14,731	14,333	13,536	13,138	5,574	14,333	13,934	12,740	12,342	11,944
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	796	796	796	796	398	796	796	796	796	796
Replacement Plants-Gas	0	0	0	790	2,765	0	0	0	0	0
New Capacity-Gas	0	0	0	0	5,135	0	0	0	0	0
Total of above	15,527	15,527	16,324	17,512	15,466	15,129	15,129	15,926	16,722	16,722

Table 10A. YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Number of Plants
10 % Increase in IGCC Capital Cost & Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500

SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced				Partially Advanced			
Carbon Tax	None				25				50				75				100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,738	95,737	95,740	95,751	95,749	96,049	96,019	98,419	95,973	96,273	96,828	102,492	98,104	96,825	97,355	104,404	102,474	98,561	97,895
Total New Capacity Required, MW	15,112	15,128	15,128	15,128	15,436	15,526	15,128	15,526	12,273	15,066	15,924	14,332	8,709	13,479	14,689	13,933	4,752	6,730	13,087	12,724
Total Region Capacity Installed, MW	110,851	110,866	110,865	110,868	111,187	111,275	111,176	111,545	110,691	111,039	112,197	111,160	111,200	111,583	111,514	111,288	109,156	109,204	111,648	110,619
Overall Compliance Strategies																				
As-Is, Buy Allowances	21	24	24	24	19	25	24	25	22	23	25	23	21	23	24	23	20	22	24	24
Retrofit Existing Plant	268	266	266	266	270	265	266	264	258	265	263	264	229	255	263	261	150	221	253	257
Fuel Switch	1	0	0	0	1	0	0	0	2	1	0	0	10	3	0	0	16	4	2	0
Retirements	0	0	0	0	0	0	0	0	8	0	1	2	30	7	1	4	104	43	9	3
Replacement With New Gas	0	0	0	0	0	0	0	0	8	0	0	0	30	7	1	1	104	43	9	3
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0
Repower	0	0	0	0	0	0	0	0	0	1	1	1	0	2	2	2	0	0	2	5
Additional Capacity-Gas	5	0	0	0	29	0	0	0	22	20	0	0	16	18	13	0	8	12	16	5
Additional Capacity-Coal	33	38	38	38	10	39	38	39	9	18	40	36	6	16	24	35	4	5	17	27
Total Plants	328	328	328	328	329	329	328	328	321	328	330	326	312	324	327	325	302	307	323	321
Reference Figure																				
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	8	0	0	0	30	7	1	1	104	43	9	3
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	8	0	0	0	30	7	1	1	104	43	9	3
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	0	0	0	0	0	0	0	0	8	0	1	2	30	7	1	4	104	43	9	3
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	1	0	0	0	1	0	0	0	1	1	0	0	6	1	0	0	10	1	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	1	0	0	0	4	2	0	0	6	3	2	0
FGD	75	76	76	73	75	76	76	86	67	75	74	82	47	65	71	78	6	30	64	73
LNB	74	72	72	75	73	77	77	74	71	78	82	77	63	70	76	77	49	63	70	72
LNB/OFA	155	159	160	157	158	153	154	156	149	148	147	153	125	146	151	150	74	125	146	151
SNCR	29	25	24	21	30	27	25	20	29	28	24	23	25	27	25	23	11	20	24	25
SCR	28	29	29	28	28	28	29	32	26	30	28	32	23	25	29	33	9	18	24	26
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	4
Advanced PFBC	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	1
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	5	0	0	0	29	0	0	0	22	20	0	0	16	18	13	0	8	12	16	5
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	8	9	9	10	8	10	9	9	8	8	10	8	4	9	9	9	4	4	9	8
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	25	29	29	28	2	29	29	30	1	10	30	28	2	7	15	26	0	1	8	19
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	5	0	0	0	29	0	0	0	22	20	0	0	16	18	13	0	8	12	16	5
PC	8	9	9	10	8	10	9	9	8	8	10	8	4	9	9	9	4	4	9	8
IGCC	25	29	29	28	2	29	29	30	1	10	30	28	2	7	15	26	0	1	8	19
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Plants	38	38	38	38	39	39	38	39	31	38	40	36	22	34	37	35	12	17	33	32

Table 10B.YEAR 2010 FOSSIL POWER GENERATION FORECAST
Partially Advanced IGCC
Breakdown by Installed Gross Capacity (MWe)
10 % Increase in IGCC Capital Cost & Heat Rate

NOx Allowance Price ($/ton, Ozone and Non-Ozone Seasons) = 1500 SOx Allowance Price ($/ton) = 800

IGCC Development Level	Partially Advanced IGCC				Partially Advanced IGCC				Partially Advanced IGCC				Fully Developed Partially Advanced IGCC				Partially Advanced IGCC			
Carbon Tax	None				25				50								100			
Gas Price Escalation, %/yr	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%	0.92%	2.00%	3.00%	4.00%
RESULTS																				
Total Region Demand, GWh	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929	609,929
Total Existing Site Capacity, MW	95,738	95,738	95,737	95,740	95,751	95,749	96,049	96,019	98,419	95,973	96,273	96,828	102,492	98,104	96,825	97,355	104,404	102,474	98,561	97,895
Total New Capacity Required, MW	15,112	15,128	15,128	15,128	15,436	15,526	15,128	15,526	12,273	15,066	15,924	14,332	8,709	13,479	14,689	13,933	4,752	6,730	13,087	12,724
Total Region Capacity Installed, MW	110,851	110,866	110,865	110,868	111,187	111,275	111,176	111,545	110,691	111,039	112,197	111,160	111,200	111,583	111,514	111,288	109,156	109,204	111,648	110,619
Overall Compliance Strategies																				
Existing Non-Fossil	11,879	11,879	11,879	11,879	11,879	11,879	11,869	12,072	11,827	12,258	12,646	13,003	11,769	12,659	12,608	13,799	11,343	11,659	12,630	14,006
As-Is, Buy Allowances	1,509	1,801	1,801	2,093	1,338	2,116	1,752	2,081	1,600	1,663	2,116	1,663	1,557	1,663	1,798	1,663	2,015	2,151	2,277	2,277
Retrofit Existing Plant	82,215	82,058	82,058	81,769	82,398	81,755	82,427	81,866	81,598	81,916	81,511	82,162	76,038	80,757	82,024	81,494	47,542	71,320	79,958	80,428
Fuel Switch	136	0	0	0	136	0	0	0	234	136	0	0	1,278	260	0	0	2,422	358	141	0
Retirements	0	0	0	0	0	0	0	0	3,160	0	398	796	11,851	2,765	395	1,593	41,083	16,986	3,555	1,185
Replacement With New Gas	0	0	0	0	0	0	0	0	3,160	0	0	0	11,851	2,765	395	398	41,083	16,986	3,555	1,185
Replacement With New Coal	0	0	0	0	0	0	0	0	0	0	398	796	0	0	0	1,194	0	0	0	0
Repower	0	0	0	0	0	0	0	0	0	379	379	379	0	790	777	777	0	0	774	1,972
Additional Capacity-Gas	1,975	0	0	0	11,456	0	0	0	8,691	7,901	0	0	6,320	7,110	5,135	0	3,160	4,740	6,320	1,975
Additional Capacity-Coal	13,137	15,128	15,128	15,128	3,980	15,526	15,128	15,526	3,582	7,165	15,924	14,332	2,388	6,369	9,554	13,933	1,592	1,990	6,767	10,748
Total Capacity	98,972	98,987	98,986	98,989	99,308	99,396	99,307	99,473	95,704	99,160	99,930	98,536	87,581	96,949	99,289	97,868	56,731	80,560	96,237	97,400
Replacement Plant Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	0	0	0	0	0	0	0	0	3,160	0	0	0	11,851	2,765	395	398	41,083	16,986	3,555	1,185
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	398	796	0	0	0	1,194	0	0	0	0
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement Plant Technologies-Summary																				
NGCC	0	0	0	0	0	0	0	0	3,160	0	0	0	11,851	2765.19	395.027	398.128	41,083	16,986	3555.24	1185.08
PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IGCC	0	0	0	0	0	0	0	0	0	0	398	796	0	0	0	1194.38	0	0	0	0
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Capacity	0	0	0	0	0	0	0	0	3,160	0	398	796	11,851	2,765	395	1,593	41,083	16,986	3,555	1,185
Retrofit Technologies																				
Year Round Nat. Gas Fuel Switch	136	0	0	0	136	0	0	0	136	136	0	0	941	91	0	0	1,777	91	0	0
Seasonal Nat. Gas Fuel Switch	0	0	0	0	0	0	0	0	98	0	0	0	337	169	0	0	645	267	141	0
FGD	26,403	26,496	26,496	26,184	26,415	26,508	26,817	28,499	25,973	26,355	26,266	28,078	21,670	25,134	26,273	27,317	2,035	14,035	24,997	26,644
LNB	8,017	7,578	7,541	8,513	7,110	8,383	8,428	8,256	7,412	8,367	9,812	8,183	6,613	7,680	7,848	8,372	3,164	5,511	7,068	7,151
LNB/OFA	58,302	59,362	59,467	58,206	59,392	58,370	58,881	58,573	58,358	57,653	56,899	58,942	53,201	57,162	58,737	58,085	35,051	51,851	57,728	58,769
SNCR	15,984	13,498	12,923	11,568	16,230	14,120	13,390	10,257	15,855	15,420	12,875	12,206	14,337	15,265	14,175	12,328	6,664	12,136	13,628	13,761
SCR	11,837	10,871	10,871	11,948	11,837	10,632	10,870	11,671	12,088	12,567	10,630	11,671	10,466	11,935	12,474	12,309	4,501	8,560	11,765	11,260
Repower Technologies																				
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	398	398	0	0	0	1,593
Advanced PFBC	0	0	0	0	0	0	0	0	0	379	379	379	0	0	379	379	0	0	379	379
Additional Capacity Technologies-Specific																				
FA NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G NGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H NGCC	1,975	0	0	0	11,456	0	0	0	8,691	7,901	0	0	6,320	7,110	5,135	0	3,160	4,740	6,320	1,975
Subcritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Supercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ultrasupercritical PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced Ultrasupercritical PC	3,184	3,582	3,582	3,980	3,184	3,980	3,582	3,582	3,184	3,184	3,980	3,184	1,592	3,582	3,582	3,582	1,592	1,592	3,582	3,184
Current IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermediate IGCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced IGCC	9,953	11,546	11,546	11,148	796	11,546	11,546	11,944	398	3,981	11,944	11,148	796	2,787	5,972	10,351	0	398	3,185	7,564
BPFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Advanced PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Coal Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo - High Gas Option	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Additional Power Technologies-Summary																				
NGCC	1,975	0	0	0	11,456	0	0	0	8,691	7,901	0	0	6,320	7,110	5,135	0	3,160	4,740	6,320	1,975
PC	3184	3582	3582	3980	3184	3980	3582	3582	3184	3184	3980	3184	1592	3582	3582	3582	1592	1592	3582	3184
IGCC	9,953	11,546	11,546	11,148	796	11,546	11,546	11,944	398	3,981	11,944	11,148	796	2,787	5,972	10,351	0	398	3,185	7,564
PFBC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CoCo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total CapacityPlants	15,112	15,128	15,128	15,128	15,436	15,526	15,128	15,526	12,273	15,066	15,924	14,332	8,709	13,479	14,689	13,933	4,752	6,730	13,087	12,724

Table 10C. Power Market Potential for IGCC in the ECAR NERC Region of the U.S.
Partially Advanced IGCC
10 % Increase in IGCC Capital Cost & Heat Rate

Gas Price Escalation, %/yr	0.92%					2.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	25	2	1	2	0	29	29	10	7	1
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	8	9	9	10	8	10	9	9	8	8
Replacement Plants-Gas	0	0	8	30	104	0	0	0	7	43
New Capacity-Gas	5	29	22	16	8	0	0	20	18	12
Total of above	38	40	40	58	120	39	38	40	40	64
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	0	0	0	0	0	0	0	0
New Capacity-IGCC	9,953	796	398	796	0	11,546	11,546	3,981	2,787	398
Replacement Plants-Other Coal (inc CoCo)	0	0	0	0	0	0	0	1	0	0
New Capacity-Other Coal (inc CoCo)	0	0	0	0	0	0	0	0	0	0
Replacement Plants-Gas	0	0	3,160	11,851	41,083	0	0	0	2,765	16,986
New Capacity-Gas	1975.135	11455.78	8,691	6,320	3,160	0	0	7900.54	7,110	4,740
Total of above	11,928	12,252	12,249	18,967	44,243	11,546	11,546	11,883	12,663	22,125

Gas Price Escalation, %/yr	3.00%					4.00%				
Carbon Tax, $/Tonne C	0	25	50	75	100	0	25	50	75	100
Number of Plants										
Replacement Plants-IGCC	0	0	1	1	0	0	0	2	4	4
New Capacity-IGCC	29	29	30	15	8	28	30	28	26	19
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	9	9	9	10	8	10	9	9	8	8
Replacement Plants-Gas	0	0	0	1	9	0	0	0	1	3
New Capacity-Gas	0	0	0	13	16	0	0	0	0	5
Total of above	38	38	41	41	42	38	39	40	40	40
Installed Capacity, MW gross										
Replacement Plants-IGCC	0	0	398	398	0	0	0	796	1,593	1,593
New Capacity-IGCC	11,546	11,546	11,944	5,972	3,185	11,148	11,944	11,148	10,351	7,564
Replacement Plants-Other Coal (inc CoCo)	0	0	1	1	1	0	0	1	1	1
New Capacity-Other Coal (inc CoCo)	3,582	3,582	3,980	3,582	3,582	3,980	3,582	3,184	3,582	3,184
Replacement Plants-Gas	0	0	0	395	3,555	0	0	0	398	1,185
New Capacity-Gas	0	0	0	5,135	6,320	0	0	0	0	1,975
Total of above	15,128	15,128	16,323	15,483	16,644	15,128	15,526	15,129	15,925	15,502

Table 11. Allowance Purchase Example

Plant: Pleasants — Unit #: 1
Capacity Factor (%): 61.29 — Carbon Tax ($/tonne C): 100

Existing Controls: NOx LNB/OFA; SOx FGD

2010 Fuel Price ($/MM Btu): Coal 0.764; Natural Gas 3.53

Control Retrofit Options											
Configuration	"as-is"	LNB	LNB/ OFA	SNCR	SNCR/ LNB	SNCR/ LNB/ OFA	SCR	SCR/LNB	SCR/LNB/OFA	Coal Reburn	NG Reburn
Capital Cost, $/kW	0	N/A	N/A	13	N/A	N/A	82	N/A	N/A	4	14
Capacity Penalty (%)		N/A	N/A	0.0%	N/A	N/A	0.1%	N/A	N/A	0.0%	0.0%
Efficiency Penalty (%)		N/A	N/A	0.07%	N/A	N/A	0.00%	N/A	N/A	0.61%	1.00%
Heat Rate, Btu/kWh	9,795	N/A	N/A	9,802	N/A	N/A	9,808	N/A	N/A	9,855	9,893
Net Capacity (MW)	614.00	N/A	N/A	614.00	N/A	N/A	613.15	N/A	N/A	614.00	614.00
Emissions (lb/MWh)											
NOX	2.06	N/A	N/A	1.44	N/A	N/A	0.21	N/A	N/A	1.55	0.83
SO2	10.87	N/A	N/A	10.88	N/A	N/A	10.89	N/A	N/A	10.94	9.33
CO2	2,010	N/A	N/A	2,011	N/A	N/A	2,013	N/A	N/A	2,022	1,893
Annual Generation(MWh)	3,317,681	N/A	N/A	3,317,681	N/A	N/A	3,313,101	N/A	N/A	3,317,681	3,317,681
Annual Costs											
Coal, $M	$24,837	N/A	N/A	$24,854	N/A	N/A	$24,869	N/A	N/A	$24,988	$25,085
Natural Gas, $M	$0	N/A	N/A	$0	N/A	N/A	$0	N/A	N/A	$0	$14,291
Fixed O&M, $M	$12,292	N/A	N/A	$12,658	N/A	N/A	$13,559	N/A	N/A	$12,522	$12,477
Variable O&M, $M	$11,091	N/A	N/A	$12,076	N/A	N/A	$11,491	N/A	N/A	$11,101	$11,091
Catalyst Repl, $M	$0	N/A	N/A	$0	N/A	N/A	$1,187	N/A	N/A	$0	$0
Liquids Revenue, $M	$0	N/A	N/A	$0	N/A	N/A	$0	N/A	N/A	$0	$0
Emissions Costs, $M	$102,087	N/A	N/A	$100,621	N/A	N/A	$97,473	N/A	N/A	$101,423	$92,186
Capital Charge, $M	$0	N/A	N/A	$1,197	N/A	N/A	$7,792	N/A	N/A	$397	$1,329
Total, $M	$150,307	N/A	N/A	$151,406	N/A	N/A	$156,372	N/A	N/A	$150,432	$156,460
Power Cost ($/MWh)	**45.30**	**N/A**	**N/A**	**45.64**	**N/A**	**N/A**	**47.20**	**N/A**	**N/A**	**45.34**	**47.16**

	Best Retrofit	Repower/Replacement Options		New Capacity and Repower or Replacement Options	
Configuration	Existing PC	Existing PC	Repower	New Gas	New Coal
Technology	"as-is"	Gas Conversion		H NGCC	Adv Air IGCC
Fuel	Coal	NG	N/A	Nat Gas	Coal
Capital Cost ($/kW)	0	15	N/A	498	961
Net Capacity (MW)	614	614	N/A	395	398
Heat Rate, Btu/kWh	9,795	10441	N/A	6,396	6,870
Capacity Penalty (%)	0.0%	-0.83	N/A	0	0
Efficiency Penalty (%)	0	6.6	N/A	0	0
Emissions (lb/MWh)					
NOX	2.06	1.15	N/A	0.19	0.16
SO2	10.87	0.00	N/A	0.00	0.04
CO2	2,010	1177	N/A	721	1,410
Annual Generation (MWh)	3,317,681	3,346,975	N/A	2,120,986	2,137,635
Annual Costs					
Coal, $M	24,837	0	N/A	0	11,224
Natural Gas, $M	0	122,815	N/A	58,061	0
Fixed O&M, $M	12,292	7,846	N/A	6,288	14,719
Variable O&M, $M	11,091	983	N/A	2,873	135
Catalyst Repl, $M	0	0	N/A	0	0
Liquids Revenue, $M	0	0	N/A	0	0
Emissions Costs, $M	102,087	51,652	N/A	19,236	37,590
Capital Charge, $M	0	1,339	N/A	28,204	58,226
Total, $M	150,307	184,634	N/A	114,662	121,894
Power Cost ($/MWh)	**45.30**	**55.16**	**N/A**	**54.06**	**57.02**

Table 12. Technology Retrofit Example

Plant:	**Spurlock**	**Unit #:**	**2**	**Existing Controls**	**2010 Fuel Price ($/MM Btu)**
Capacity Factor (%):	**58.82%**	**Carbon Tax ($/tonne C):**	**100**	**NOx** LNB/OFA	**Coal** 0.72
				SOx FGD	**Natural Gas** 3.53

Control Retrofit Options											
Configuration	**"as-is"**	**LNB**	**LNB/ OFA**	**SNCR**	**SNCR/ LNB**	**SNCR/ LNB/ OFA**	**SCR**	**SCR/LNB**	**SCR/LNB/OFA**	**Coal Reburn**	**NG Reburn**
Capital Cost, $/kW	0	N/A	N/A	14	N/A	N/A	82	N/A	N/A	5	14
Capacity Penalty (%)	0.0%	N/A	N/A	0.0%	N/A	N/A	0.1%	N/A	N/A	0.0%	0.0%
Efficiency Penalty (%)	0.00%	N/A	N/A	0.38%	N/A	N/A	0.00%	N/A	N/A	0.61%	1.00%
Heat Rate, Btu/kWh	9,880	N/A	N/A	9,918	N/A	N/A	9,893	N/A	N/A	9,940	9,979
Net Capacity (MW)	500.00	N/A	N/A	500.00	N/A	N/A	499.31	N/A	N/A	500.00	500.00
Emissions (lb/MWh)											
NOX	11.46	N/A	N/A	8.05	N/A	N/A	1.15	N/A	N/A	8.65	4.63
SO2	10.22	N/A	N/A	10.25	N/A	N/A	10.23	N/A	N/A	10.28	8.77
CO2	2,027	N/A	N/A	2,035	N/A	N/A	2,030	N/A	N/A	2,040	1,909
Annual Generation(MWh)	2,576,518	N/A	N/A	2,576,518	N/A	N/A	2,572,962	N/A	N/A	2,576,518	2,576,518
Annual Costs											
Coal, $M	$24,368	N/A	N/A	$24,461	N/A	N/A	$24,400	N/A	N/A	$24,517	$24,612
Natural Gas, $M	$0	N/A	N/A	$0	N/A	N/A	$0	N/A	N/A	$0	$11,238
Fixed O&M, $M	$12,003	N/A	N/A	$12,353	N/A	N/A	$13,028	N/A	N/A	$12,183	$12,150
Variable O&M, $M	$2,342	N/A	N/A	$6,617	N/A	N/A	$4,082	N/A	N/A	$2,349	$2,342
Catalyst Repl, $M	$0	N/A	N/A	$0	N/A	N/A	$882	N/A	N/A	$0	$0
Liquids Revenue, $M	$0	N/A	N/A	$0	N/A	N/A	$0	N/A	N/A	$0	$0
Emissions Costs, $M	$97,333	N/A	N/A	$91,033	N/A	N/A	$77,394	N/A	N/A	$92,356	$78,876
Capital Charge, $M	$0	N/A	N/A	$996	N/A	N/A	$6,238	N/A	N/A	$367	$1,050
Total, $M	$136,046	N/A	N/A	$135,461	N/A	N/A	$126,024	N/A	N/A	$131,773	$130,268
Power Cost ($/MWh)	**52.80**	**N/A**	**N/A**	**52.58**	**N/A**	**N/A**	**48.98**	**N/A**	**N/A**	**51.14**	**50.56**

	Best Retrofit	**Repower/Replacement Options**		**New Capacity and Repower or Replacement Options**	
Configuration	**Existing PC**	**Existing PC**	**Repower**	**New Gas**	**New Coal**
Technology	**SCR**	**Gas Conv**		**H NGCC**	**Adv Air IGCC**
Fuel	Coal	Nat Gas		Nat Gas	Coal
Capital Cost ($/kW)	82	15	N/A	489	961
Net Capacity (MW)	500	504.4	N/A	395	398
Heat Rate, Btu/kWh	9,893	10532.08	N/A	6,396	6,870
Capacity Penalty (%)	0.1%	-0.83	N/A	0	0
Efficiency Penalty (%)	0.00%	6.6	N/A	0	0
Emissions (lb/MWh)					
NOX	1.15	1.1585288	N/A	0.192	0.16
SO2	10.23	0.00	N/A	0.00	0.04
CO2	2,030	1187.378233	N/A	721	1,410
Annual Generation (MWh)	2,572,962	2,599,268	N/A	2,035,589	2,051,568
Annual Costs					
Coal, $M	24,400	0	N/A	0	13,492
Natural Gas, $M	0	96,122	N/A	58,061	0
Fixed O&M, $M	13,028	7,713	N/A	6,288	14,719
Variable O&M, $M	4,082	738	N/A	2,757	130
Catalyst Repl, $M	882	0	N/A	0	0
Liquids Revenue, $M	0	0	N/A	0	0
Emissions Costs, $M	77,394	40,461	N/A	18,462	36,074
Capital Charge, $M	6,238	1,078	N/A	27,682	58,226
Total, $M	126,024	146,112	N/A	113,250	122,641
Power Cost ($/MWh)	**48.98**	**56.21**	**N/A**	**55.63**	**59.78**

Table 13. Existing Boiler Replacement Example

Plant: Hatfield Power Station
Capacity Factor (%): 79.63%

Unit #: 1
Carbon Tax ($/tonne C): 100

Existing Controls	
NOx	LNB
SOx	None

2010 Fuel Price ($/MM Btu)	
Coal	1.17
Natural Gas	3.53

Control Retrofit Options													
Configuration	"as-is"	LNB	LNB/ OFA	SNCR	SNCR/ LNB	SNCR/ LNB/ OFA	SCR	SCR/LNB	SCR/LNB/OFA	Coal Reburn	NG Reburn	FGD	LNB/ OFA/New FGD
Capital Cost, $/kW	0	N/A	21	16	16	37	92	92	113	26	16	208	276
Capacity Penalty (%)	0.0%	N/A	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	1.5%	1.5%
Efficiency Penalty (%)	0.00%	N/A	0.02%	0.14%	0.14%	0.11%	0.00%	0.00%	0.02%	0.61%	1.00%	0.00%	0.02%
Heat Rate, Btu/kWh	9,564	N/A	9,566	9,578	9,578	9,574	9,576	9,576	9,578	9,622	9,660	9,707	9,709
Net Capacity (MW)	555.01	N/A	555.01	555.01	555.01	555.01	554.24	554.24	554.24	555.01	555.01	546.15	492.02
Emissions (lb/MWh)													
NOX	4.21	N/A	2.53	2.95	2.95	1.77	0.42	0.42	0.25	3.18	1.70	4.21	2.56
SO2	29.73	N/A	29.74	29.78	29.78	29.77	29.77	29.77	29.78	29.92	25.53	1.51	1.51
CO2	1,963	N/A	1,963	1,965	1,965	1,965	1,965	1,965	1,965	1,975	1,848	2,012	2,012
Annual Generation(MWh)	3,719,148	N/A	3,719,148	3,719,148	3,719,148	3,719,148	3,714,014	3,714,014	3,714,014	3,719,148	3,719,148	3,659,800	3,659,800
Annual Costs													
Coal, $M	$41,730	N/A	$41,738	$41,790	$41,790	$41,782	$41,784	$41,784	$41,800	$41,984	$42,147	$42,356	$42,364
Natural Gas, $M	$0	N/A	$0	$0	$0	$0	$0	$0	$0	$0	$14,867	$0	$0
Fixed O&M, $M	$8,659	N/A	$8,912	$9,017	$9,017	$9,270	$9,944	$9,944	$10,196	$8,903	$8,852	$11,443	$11,696
Variable O&M, $M	$2,266	N/A	$2,266	$4,527	$4,527	$3,622	$3,090	$3,090	$2,782	$2,280	$2,266	$5,315	$5,315
Catalyst Repl, $M	$0	N/A	$0	$0	$0	$0	$1,000	$1,000	$1,000	$0	$0	$0	$0
Liquids Revenue, $M	$0	N/A	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Emissions Costs, $M	$146,319	N/A	$141,652	$143,004	$143,004	$139,660	$135,743	$135,743	$135,301	$144,259	$127,800	$104,908	$100,412
Capital Charge, $M	$0	N/A	$1,708	$1,279	$1,279	$2,988	$7,766	$7,766	$9,579	$2,193	$1,383	$17,613	$20,632
Total, $M	$327,352	N/A	$323,421	$328,320	$326,088	$323,897	$331,075	$331,802	$333,662	$328,482	$326,962	$268,133	$268,070
Power Cost ($/MWh)	**56.64**	**N/A**	**55.96**	**56.81**	**56.43**	**56.05**	**57.37**	**57.49**	**57.82**	**56.84**	**56.58**	**47.15**	**46.45**

	Best Retrofit	Repower/Replacement Options		New Capacity and Repower or Replacement Options	
Configuration	Existing PC	Existing PC		New Gas	New Coal
Technology	LNB/ OFA/New FGD	Gas Conv	Repower	H NGCC	Adv Air IGCC
Fuel	Coal	Nat Gas		Nat Gas	Coal
Capital Cost ($/kW)	276	15	N/A	503	961
Capacity (MWg)	492	504.4148936	N/A	395	398
Heat Rate, Btu/kWh	9,709	10195.224	N/A	6,396	6,870
Capacity Penalty (%)	1.5	-0.83	N/A	0	0
Efficiency Penalty (%)	0.02%	6.6	N/A	0	0
Emissions (lb/MWh)					
NOX	2.56	1.12147464	N/A	0.192	0.16
SO2	1.51	0.00	N/A	0.00	0.11
CO2	2,012	1149.401358	N/A	721	1,410
Annual Generation (MWh)	3,659,800	3,751,987	N/A	2,755,562	2,777,193
Annual Costs					
Coal, $M	42,364	0	N/A	0	22,383
Natural Gas, $M	0	136,042	N/A	58,061	0
Fixed O&M, $M	11,696	7,083	N/A	6,288	14,719
Variable O&M, $M	5,315	1,365	N/A	3,732	176
Catalyst Repl, $M	0	0	N/A	0	0
Liquids Revenue, $M	0	0	N/A	0	0
Emissions Costs, $M	100,412	56,536	N/A	24,992	48,913
Capital Charge, $M	20,632	1,197	N/A	28,465	58,226
Total, $M	180,418	202,223	N/A	121,538	144,417
Power Cost ($/MWh)	**49.30**	**53.90**	**N/A**	**44.11**	**52.00**

Table 14. Repowering Example

Plant: Burger | Unit #: 5
Capacity Factor (%): 84.22% | Carbon Tax ($/tonne C): 100

Existing Controls	
NOx	None
SOx	None

2010 Fuel Price ($/MM Btu)	
Coal	0.81
Natural Gas	5.21

Control Retrofit Options													
Configuration	"as-is"	LNB	LNB/ OFA	SNCR	SNCR/ LNB	SNCR/ LNB/ OFA	SCR	SCR/LNB	SCR/LNB/OFA	Coal Reburn	NG Reburn	FGD	LNB/OFA/FGD
Capital Cost, $/kW	0	0	25	18	18	43	117	117	141	92	14	289	313
Capacity Penalty (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	1.5%	1.5%
Efficiency Penalty (%)	0.00%	0.00%	0.02%	0.16%	0.16%	0.09%	0.00%	0.00%	0.02%	0.61%	1.00%	0.00%	0.02%
Heat Rate, Btu/kWh	10,541	10,541	10,543	10,558	10,558	10,551	10,555	10,555	10,557	10,605	10,646	10,699	10,701
Net Capacity (MW)	156.00	156.00	156.00	156.00	156.00	156.00	155.78	155.78	155.78	156.00	156.00	153.51	153.51
Emissions (lb/MWh)													
NOX	5.17	5.17	2.32	3.62	3.62	1.63	0.52	0.52	0.23	2.60	2.09	5.17	2.32
SO2	44.04	44.04	44.05	44.11	44.11	44.08	44.10	44.10	44.11	44.31	37.81	2.24	2.24
CO2	2,160	2,160	2,160	2,163	2,163	2,162	2,163	2,163	2,163	2,173	2,034	2,222	2,222
Annual Generation(MWh)	1,150,884	1,150,884	1,150,884	1,150,884	1,150,884	1,150,884	1,149,295	1,149,295	1,149,295	1,150,884	1,150,884	1,132,518	1,132,518
Annual Costs													
Coal, $M	$9,874	$9,874	$9,876	$9,890	$9,890	$9,885	$9,887	$9,887	$9,891	$9,934	$9,973	$10,022	$10,024
Natural Gas, $M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$7,800	$0	$0
Fixed O&M, $M	$4,680	$4,680	$4,762	$4,954	$4,954	$5,036	$5,187	$5,187	$5,269	$5,060	$4,726	$6,355	$6,437
Variable O&M, $M	$781	$781	$781	$1,741	$1,741	$1,213	$1,149	$1,149	$957	$810	$781	$2,149	$2,149
Catalyst Repl, $M	$0	$0	$0	$0	$0	$0	$271	$271	$271	$0	$0	$0	
Liquids Revenue, $M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Emissions Costs, $M	$55,501	$55,501	$53,059	$54,250	$54,250	$52,495	$51,484	$51,484	$51,249	$53,597	$48,186	$36,548	$34,107
Capital Charge, $M	$0	$0	$551	$411	$411	$962	$2,771	$2,771	$3,356	$2,191	$328	$6,869	$7,420
Total, $M	$70,836	$70,836	$69,029	$71,247	$71,247	$69,592	$70,750	$70,750	$70,993	$71,592	$71,793	$61,944	$60,138
Power Cost ($/MWh)	**61.55**	**61.55**	**59.98**	**61.91**	**61.91**	**60.47**	**61.56**	**61.56**	**61.77**	**62.21**	**62.38**	**54.70**	**53.10**

	Repower/Replacement Options			New Capacity and Repower or Replacement Options	
Configuration	**Existing PC**	**Existing PC**	**Adv PFBC**	**New Gas**	**New Coal**
Technology	**LNB/OFA/FGD**	**Gas Conv**	**Repower**	**H NGCC**	**Adv Air IGCC**
Fuel	Coal	Nat Gas	Coal	Nat Gas	Coal
Capital Cost ($/kW)	313	15	689	489	961
Net Capacity (MW)	154	157	379	395	398
Heat Rate, Btu/kWh	10,701	11,237	7,487	6,396	6,870
Capacity Penalty (%)	1.5%	-0.83	N/A	0	0
Efficiency Penalty (%)	0.02%	6.60%	N/A	0	0
Emissions (lb/MWh)					
NOX	2.32	1.24	0.98	0.192	0.16
SO2	2.24	0.00	1.68	0.00	0.14
CO2	2,222	1,267	1,534	721	1,408
Annual Generation (MWh)	1,132,518	1,161,046	2,797,304	2,914,296	2,937,173
Annual Costs					
Coal, $M	10,024	0	17,047	0	16,424
Natural Gas, $M	0	68,011	0	85,792	0
Fixed O&M, $M	6,437	3,996	13,221	6,288	14,719
Variable O&M, $M	2,149	471	6,544	3,947	186
Catalyst Repl, $M	0	0	0	0	0
Liquids Revenue, $M	0	0	0	0	0
Emissions Costs, $M	34,107	19,282	57,059	26,431	51,699
Capital Charge, $M	7,420	336	39,762	27,682	58,226
Total, $M	60,138	92,096	133,633	150,140	141,253
Power Cost ($/MWh)	**53.10**	**79.32**	**47.77**	**51.52**	**48.09**

Table 15. New Capacity Options - New Gas

2010 Coal Price ($/MM Btu): 0.764 | 2010 Natural Gas Price ($/MM Btu): 3.53 | Carbon Tax ($/tonne): 100 | Plant Site: Pleasants

Technology	NGCC	NGCC	NGCC	PC	PC	PC	PC	IGCC	IGCC	IGCC	IGCC	PFBC	PFBC	CoCo	CoCo
Configuration	FA Turbine	G Turbine	H Turbine	Sub Critical	Super Critical	Ultra Super Crit	Adv USP	Advanced Air	Current Oxygen	Part Adv Ox	Adv Ox	Current	Advanced	High Coal	High Gas
Fuel	Nat Gas	Nat Gas	Nat Gas	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal/Gas	Gas/Coal
Capital Cost ($/kW)	657	566	498	1220	1267	1264	1064	961	1341	1328	1174	1286	1081	1539	1158
Capacity (MWg)	246.2	334.0	403.3	422.2	427.1	425.0	415.9	411.2	648.5	403.3	490.1	453.3	401.8	460.2	450.3
Heat Rate, Btu/kWh	7,359	6,743	6,396	9,077	8,568	8,251	8,266	6,870	8,522	7,513	6,968	8,354	7,269	11,721	9,258
Emissions (lb/MWh)															
NOX	0.86	0.20	0.19	4.09	1.35	1.35	0.49	0.16	0.21	0.18	0.17	0.41	0.95	0.11	0.06
SO2	0.00	0.00	0.00	0.80	0.38	0.36	0.46	0.04	0.10	0.06	0.04	0.50	0.43	0.17	0.10
CO2	830	760	721	1,863	1,758	1,693	1,696	1,410	1,749	1,542	1,430	1,714	1,492	1,941	1,295
Annual Generation (MWh)	1,424,288	1,945,221	2,356,081	2,370,724	2,396,615	2,383,720	2,373,813	2,374,577	3,239,778	2,374,577	2,551,163	2,532,537	2,213,873	2,747,182	2,525,606
Annual Costs															
Coal, $M	0	0	0	16,447	15,694	15,032	14,997	12,468	21,101	13,635	13,586	16,170	12,299	24,610	17,871
Natural Gas, $M	40,384	50,537	58,061	0	0	0	0	0	0	0	0	0	0	36,692	43,920
Fixed O&M, $M	$3,884	$5,219	$6,288	$10,662	$11,064	$10,989	$10,946	$14,719	$19,995	$14,625	$16,497	$12,399	$13,221	$15,281	$10,294
Variable O&M, $M	$550	$2,489	$3,191	$5,341	$8,404	$4,819	$4,929	$150	-$776	$423	$468	$5,022	$6,340	$3,859	$1,930
Catalyst Repl, $M	$0	$0	$0	$0	$0	$0	$487	$0	$0	$0	$0	$0	$0	$0	$0
Liquids Revenue, $M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$29,845	-$14,922
Emissions Costs, $M	$15,545	$18,599	$21,369	$62,691	$54,946	$52,717	$51,138	$41,756	$70,765	$45,697	$45,511	$55,017	$42,841	$66,411	$40,701
Capital Charge, $M	$22,474	$26,464	$28,204	$73,778	$77,503	$76,889	$64,448	$58,226	$110,835	$80,442	$76,454	$83,083	$61,069	$107,889	$74,617
Total, $M	$82,836	$103,308	$117,113	$168,918	$167,611	$160,446	$146,945	$127,320	$221,921	$154,821	$152,516	$171,690	$135,770	$224,898	$174,409
Power Cost ($/MWh)	58.16	53.11	49.71	71.25	69.94	67.31	61.90	53.62	68.50	65.20	59.78	67.79	61.33	81.86	69.06

Table 16. New Capacity Options - New Coal

2010 Coal Price ($/MM Btu): 0.814 **2010 Natural Gas Price ($/MM Btu):** 5.21 **Carbon Tax ($/tonne):** 100 **Plant Site:** Burger

Technology	**NGCC**	**NGCC**	**NGCC**	**PC**	**PC**	**PC**	**PC**	**IGCC**	**IGCC**	**IGCC**	**IGCC**	**PFBC**	**PFBC**	**CoCo**	**CoCo**
Configuration	**FA Turbine**	**G Turbine**	**H Turbine**	**Sub Critical**	**Super Critical**	**Ultra Super Crit**	**Adv USP**	**Advanced Air**	**Current Oxygen**	**Part Adv Ox**	**Adv Ox**	**Current**	**Advanced**	**High Coal**	**High Gas**
Fuel	Nat Gas	Nat Gas	Nat Gas	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal	Coal/Gas	Gas/Coal
Capital Cost ($/kW)	645	556	489	1197	1244	1241	1064	961	1316	1303	1153	1262	1061	1511	1136
Capacity (MWg)	246.2	334.0	403.3	422.2	427.1	425.0	415.9	411.2	648.5	403.3	490.1	453.3	401.8	460.2	450.3
Heat Rate, Btu/kWh	7,359	6,743	6,396	9,077	8,568	8,251	8,266	6,870	8,522	7,513	6,968	8,354	7,269	11,721	9,258
Emissions (lb/MWh)															
NOX	0.86	0.20	0.19	4.09	1.35	1.35	0.10	0.16	0.21	0.18	0.17	0.08	0.19	0.04	0.03
SO2	0.00	0.00	0.00	3.03	1.43	1.38	1.73	0.14	0.37	0.24	0.15	1.87	1.63	0.66	0.36
CO2	830	760	721	1,860	1,756	1,691	1,694	1,408	1,746	1,539	1,428	1,712	1,489	1,938	1,294
Annual Generation (MWh)	1,763,444	2,408,423	2,917,120	2,935,249	2,967,305	2,951,340	2,939,074	2,940,019	4,011,245	2,940,019	3,158,655	3,135,593	2,741,048	3,401,350	3,127,012
Annual Costs															
Coal, $M	0	0	0	21,686	20,693	19,820	19,774	16,440	27,823	17,978	17,914	21,321	16,217	32,449	23,564
Natural Gas, $M	59,671	74,674	85,792	0	0	0	0	0	0	0	0	0	0	67,084	80,298
Fixed O&M, $M	$3,884	$5,219	$6,288	$10,662	$11,064	$10,989	$12,395	$14,719	$19,995	$14,625	$16,497	$12,399	$13,221	$15,281	$10,294
Variable O&M, $M	$681	$3,082	$3,951	$6,612	$10,405	$5,966	$5,356	$186	-$961	$523	$579	$7,708	$7,849	$5,921	$2,960
Catalyst Repl, $M	$0	$0	$0	$0	$0	$0	$487	$0	$0	$0	$0	$0	$0	$0	$0
Liquids Revenue, $M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	-$36,953	-$18,476
Emissions Costs, $M	$19,247	$23,028	$26,457	$80,140	$69,185	$66,378	$63,865	$51,749	$87,930	$56,700	$56,401	$68,982	$52,721	$82,600	$50,600
Capital Charge, $M	$22,057	$25,974	$27,682	$72,412	$76,068	$75,465	$64,448	$58,226	$108,783	$78,952	$75,039	$81,545	$59,938	$105,891	$73,235
Total, $M	$105,540	$131,977	$150,170	$191,512	$187,415	$178,618	$166,325	$141,319	$243,571	$168,779	$166,430	$191,954	$149,947	$272,274	$222,475
Power Cost ($/MWh)	**59.85**	**54.80**	**51.48**	**65.25**	**63.16**	**60.52**	**56.59**	**48.07**	**60.72**	**57.41**	**52.69**	**61.22**	**54.70**	**80.05**	**71.15**